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ADMIRAL SIR FREDERICK W. E. NICOLSON, Bart., C.B., Vice-President, in the Chair.

THE PUMPING ARRANGEMENTS OF MODERN WAR-SHIPS.

By W. H. WHITE, Assistant-Constructor of the Navy.

IN selecting this subject and requesting me to prepare a paper thereon, the Council were doubtless influenced by the consideration that naval Officers necessarily take much interest in the pumping arrangements of the ships in which they have to serve. It has been my endeavour throughout the paper to keep the same consideration in view, and to treat the subject in a manner which may be practically useful to naval Officers, who are concerned rather with the proper use of the appliances for drainage and pumping than with the technical details of those appliances. No descriptions are given of the various forms of pumps in common use, nor is any estimate attempted of their relative efficiency. The same thing holds good of the subordinate but important details of pumping arrangements, which have to be carefully studied by the naval architect and marine engineer—such as Kingstons, sea-cocks, sluice-valves, &c. I have assumed that naval Officers have a general acquaintance with such details, and are familiar with their management, so that description is unnecessary. My chief aim has been to explain the principles upon which the pumping arrangements of modern war-ships are based, and so to make clear to naval Officers the intentions of the designers and builders of those ships. Apart from the intelligent comprehension of these intentions, it may happen either that the full value is not assigned to the pumping power actually provided, or that too much may be expected from it.

At the outset it is necessary to remark that no proper estimate of the value of pumps in modern war-ships can be formed apart from a consideration of the structural arrangements, and more especially of the minute watertight subdivision of the hold-space into numerous compartments. Now that iron or steel hulls are exclusively employed, except for the smaller classes of armed ships, and the thin skin-plating is liable to have large breaches made in it by ramming, torpedoes, or other under-water attacks, watertight subdivision is recognized as an essential condition in the design. As these under-water attacks have been developed, so has the subdivision been made more and more minute; and it is generally agreed that this policy is the best that can be adopted. Many ships of recent design have four separate stoke-holds, two engine-rooms, a large number of transverse and longitudinal bulkheads, watertight decks and "flats," cellular "double-bottoms" and "wing-passages," and numerous minor compartments—such as magazines, shell-rooms, shaft passages, &c.—formed primarily for convenient stowage of the hold, but made to contribute also to the safety of the ships. The extent to which subdivision is carried may be illustrated by the statement that the "Inflexible" is subdivided into 135 compartments, the French "Admiral Duperré" into nearly 200 compartments, and the "Italia" into 150 compartments below the armour deck, besides a minute subdivision of the waterline region. It is estimated also that some of our recent ships might have four to six of their largest compartments amidships bilged simultaneously, and yet keep afloat.

This minuteness of subdivision is not secured without careful consideration on the part of the designer; and its full efficiency in the time of trial must depend largely upon the closing of watertight doors, scuttles, and other openings made in the partitions to facilitate the working of ships under ordinary circumstances. Apart from the convenience of those who have to work the ships, the naval architect would gladly reduce the number of these openings, and keep the partitions intact; but as this is objected to, all possible provision is made for rapidly closing the doors either from the hold-spaces, or from the decks above. The proper manipulation of these appliances is, of course, a matter of drill, and one to which great attention is devoted in the Royal Navy.

It would be folly to assume that the most minutely subdivided ship yet constructed was *unsinkable* when attacked by the gun, the ram, and the torpedo. On the other hand, it is evident that very serious damage indeed must be done to most modern war-ships before their powers of flotation are compromised, provided always that the watertightness of the partitions is secured by closing doors, &c. Attempts have been made to discredit the value of watertight subdivision, because of occurrences such as the loss of H.M.S. "Vanguard," and the German turret-ship "Grosser Kurfurst;" but anyone who will take the trouble to ascertain the facts will find that no argument adverse to watertight subdivision can be based upon them. I have discussed the case of the "Vanguard" fully elsewhere, and shown that had it not been for her cellular construction the damage done to her sides by

the spur of the "Iron Duke" would have caused her to founder in a few minutes, instead of remaining afloat for seventy minutes and allowing time for the rescue of everyone on board.[1] Her case, in short, illustrates two points: first, the enormous value of a cellular double bottom, and its continuation above the bilges in the form of wing-passages; second, the urgent necessity for having all watertight doors, scuttles, &c., in readiness for closing quickly in case of accident. The case of the "Grosser Kurfurst" further illustrates the importance of the latter point; when she was struck the principal watertight doors are said to have been open, and it would appear that they were not closed after the collision. It has been stated, in fact, that subsequent experiments made on a model of the ship proved that even when she had been so seriously damaged, as the report of the divers showed her to have been, she could have been kept afloat had the watertight doors been closed.

These accidents, moreover, resulting from collisions so serious as to represent thoroughly successful ram attacks in action, should not be taken alone. They should be considered in relation to other occurrences where serious accidents, involving losses of life and valuable ships, have been averted by watertight subdivision. The value of double bottoms in preventing the entry of large quantities of water into the hold has been illustrated in the "Agincourt" when she grounded on the Pearl Rock. Still more recently the "Iron Duke" has grounded on a hard bottom, and crushed in considerable portions of her outer skin, without any sensible loss of buoyancy, the inner skin remaining intact and only two small compartments in the double bottom being filled. The value of transverse bulkheads has received numberless illustrations; but the case of the "Kœnig Wilhelm" only need be mentioned here. When her bow was partly wrenched off by collision with the "Grosser Kurfurst" the water was confined to the bow compartments, and the ship saved from sinking by a watertight bulkhead placed at the fore end of the battery. Further, the accidental collisions of the "Bellerophon" and "Minotaur," and of the "Hercules" and "Northumberland," have illustrated the value of "wing-passage" bulkheads as defences against ramming.

Summing up all the facts on record, it may be asserted safely that the accepted policy of construction has been justified by experience. Watertight subdivision has proved itself to be the best means yet discovered for preserving the buoyancy of war-ships when damaged in action. The extent of that damage may be so great, in extreme cases, as to cause even minutely subdivided ships to sink; but there is good reason to believe that most modern war-ships of the larger classes would not be sunk by a single successful ram or torpedo attack of the most formidable character yet devised; and it is conceivable that some ships might keep afloat under repeated attacks of the kind assumed. It is here assumed, of course, that the various watertight partitions are truly watertight, doors, scuttles, and other openings being closed. This is the single condition that needs to be fulfilled in

[1] See "Manual of Naval Architecture," page 35.

order to realize the full advantages of the method of protecting buoyancy. The damaged compartment or compartments must be isolated from the others; when this is effected, all has been done that needs immediate attention. As the inrush of water takes place after the accident, the ship sinks deeper, and possibly heels or changes trim. If the extent of the damage lies within the range of usefulness of her watertight subdivision, her maximum immersion will be reached when the extra immersion of the undamaged parts supplies the buoyancy lost by the entry of water into the damaged compartments. When this happens the inflow of water through breaches in the skin must cease; for the damaged compartments will either be full of water, or have the surface of the water in them standing at the level of the surface of the sea. Until this inrush of water ceases or is extremely slow, it must be most difficult, and often quite impossible in a seaway, to bring a sail, a mat, or any other kind of external leak-stopper, into position over a jagged hole of even moderate size situated at a considerable depth below the surface. The difficulty may be decreased by means of special fittings, such as the "hauling down lines" and chains to be found in armoured ships of the Royal Navy; but careful trials made under the most favourable conditions, in smooth water, and with all the appliances of a steam reserve or dockyard, have demonstrated conclusively that, as a rule, the inflow of water must be checked before leak-stoppers can be successfully hauled into position over a hole in the bottom of an iron or steel ship. I need not dwell upon the matter further, as it is one within the experience of all naval Officers. But I cannot help thinking that the confidence with which a commanding Officer and crew would take their ship into action, and their subsequent conduct in action, must be greatly influenced by the knowledge that her watertight subdivision alone, without any help from pumps or leak-stoppers, may be trusted to give a reasonable chance of escape from foundering, provided only that the watertight doors, &c., are closed.

The foregoing remarks apply to the cases where holes in the skin-plating are of such a size as to admit large quantities of water. Cases will arise, no doubt, where smaller damages are caused by shot-holes, or grazing blows, cracking and bulging rather than making serious breaches in the skin. The Service Regulations provide for meeting these lesser damages by means of external shot-hole stopper mats, and there have been many plans of leak-stoppers for use from within the ship, some of these plans displaying much ingenuity. But even in these cases of trifling damage, as I shall show more fully hereafter, pumping should generally begin after the stoppers are in place, and not before. There may be many exceptions to this rule, but if the pumps are used the rate of inflow of water will maintain its maximum, and the difficulties of placing the stoppers must be increased. Moreover, it may be expected that under the circumstances supposed, if the outer skin is only slightly damaged, the inner skin, or wing-passage bulkheads, will hold good, so that water can find access only to small compartments.

Having said so much respecting the primary importance of water-

tight subdivision, I pass to the consideration of the limits of usefulness of pumps. At the outset it may be remarked that pumps are not fitted for the purpose of keeping war-ships afloat when seriously damaged: they are not, in any sense, to be regarded as substitutes for watertight subdivision, but simply as auxiliaries thereto. The most powerful pumps which could be fitted in a ship destitute of watertight subdivision, could not give her one tithe of the chances of escape from foundering which would be possessed by her if minutely subdivided. This statement appears almost self-evident, yet I have reason to believe that some brief arguments in its support will not be altogether needless.

Let it be assumed, for purposes of argument, that the whole steam-producing power of the main boilers in a war-ship could be made available for pumping in case of emergency. Further let it be assumed, although this is most improbable, that when the inrush of water takes place, there is no flooding of stoke-holds, nor any loss of steam power. And, in addition, let this steam power be applied to the most efficient pumps in use, all of these pumps being supposed to be in full action, with an unchecked supply of water to them. Then it may be confidently asserted that, apart from watertight subdivision, this enormous pumping power might be overpowered by the inrush of water through the breaches in the skin, which would probably be caused in action by a successful ram or torpedo attack. I have elsewhere illustrated the importance of considering what enormous masses of water may pass into a ship through a hole of small size situated at a moderate depth under water.[1] A few figures must suffice here. Take a hole in the outer skin about 1 square foot in area, and 16 feet under water. Through this small opening the water would rush initially at the rate of 1 ton per second, or 3,600 tons per hour. This rate of inflow would equal the total pumping power available in most first-class ironclads. But, instead of having holes of the size supposed, in actual warfare the breaches in the outer skin will be enormously greater, and will admit proportionately large quantities of water. The "Iron Duke" made a breach in the "Vanguard's" outer skin from 20 to 30 square feet in area, besides disturbing the armour plates and the structure behind them. The "Grosser Kurfurst" appears to have been even worse off. The torpedo experiments made on the "Oberon," and those made at Carlscrona, show that equally serious damage may be produced by those forms of attack. In short, it would be madness to trust in pumping power alone, or chiefly, to meet such serious damage, even on the very favourable and practically impossible assumptions made above, as to the maintenance of full steam power and the efficient action of the pumps.

It may be urged, that while pumps are powerless in cases of very serious damage, they may prove capable of keeping down an ordinary leak until the ship has been run aground, or in some other way placed in more favourable circumstances than those under which the damage

[1] See "Manual of Naval Architecture," page 19.

took place. There is doubtless some truth in this view, but it has no great practical importance. For instance, it must be obvious that *hand pumps* are of no value whatever, under the conditions of even a very small leak. The most powerful hand pump in the Service, fully manned, is capable of throwing about 25 tons per hour; contrast this with the 3,600 tons per hour flowing in through a hole 1 square foot in area, 16 feet below the surface. Two or three vacant rivet-holes in the bottom plating would admit as much water as this pump could throw overboard. Passing the hand pumps by, therefore, let us look a little more closely into the possible power of the steam pumps. Here the first question requiring answer is, the probability of maintaining steam-producing power when water is rushing into the hold, and (by hypothesis) flowing freely to the pumps in immense quantities. Any general answer to the question is impossible; the chances are hard to estimate. But unless the main stoke-holds are formed into separate watertight compartments there can be no hope of keeping all the boiler power, and even when so subdivided, this hope is doubtless unreasonable. Some loss of steam power is doubtless unavoidable under the best conditions; and under the worst conditions there may be a total loss of steam power.

Another important set of questions requiring consideration, are those relating to the location of the pumps, the provision of water channels by which the pumps can be fed, and the necessary arrangements for bringing the great pumping power (assumed to be possessed by a ship) to bear upon any damaged part. Respecting these I shall offer some remarks hereafter; and simply mention them now, as a prelude to a still more critical inquiry. Supposing the pumps to be capable of keeping down a leak of considerable magnitude, what good could result from keeping the pumps at work, except in special cases, where the time thus gained would suffice to run the ship into shallow water, or enable lives to be saved by getting out boats, &c.? It is clear, that in general, an attempt to keep a ship afloat for a long period by her pumps, must simply resolve itself into a duel between the sea and the pumping power, with a result not difficult of prediction. So long as the pumps were at work, so long would the inrush of water continue; and, as explained above, the application of leak-stoppers to the breach would be most difficult, if not impossible.

From this brief statement of the case I think it may be fairly concluded that if the most sanguine estimates of possible pumping power could be fulfilled, it would still be unwise to look to pumps for great assistance in keeping ships afloat. Watertight subdivision may be trusted for this purpose, even when the damage is so serious as to swamp the most powerful pumps. Such subdivision has the further advantage of enabling external leak-stoppers to be used efficiently. When such stoppers have been fixed in position, the pumps can be set to work with some chance of clearing the water from damaged compartments, and enabling the work of temporary repairs to be proceeded with, if that be possible. No doubt, there will be many instances in which such clearance of damaged compartments will be impossible or inexpedient, the injuries being of a character not permitting of tem-

porary repairs at sea. Even then so long as the water can be confined to the damaged compartments, or the leakage therefrom dealt with by the pumps, there will be no danger of foundering, and it would be most undesirable, for the purpose of giving greater efficiency to the pumps, to make any changes that would impair the efficiency of the subdivision.

Supposing these conclusions to be accepted, it may be asked by what standard should the pumping power of a ship be measured when endeavouring to form an estimate of its efficiency? No such standard has been fixed as yet. One method of measurement takes account of the weight of water which could be thrown overboard per hour, supposing all the pumps to be in full work, and expresses this weight as a fraction of the displacement of the ship. The greater the value of the fraction—$\frac{\text{weight of water thrown overboard}}{\text{weight of ship}}$, the greater would be the efficiency according to this method. This is obviously a very crude measurement; and instead of proportioning pumping power to displacement it would be more reasonable to proportion it inversely to the "reserve of buoyancy"—that is, to the volume of the out-of-water part of a ship when she is floating at load draught in still water. For instance, if two ships are identical in under-water form, but one has twice as much height of freeboard as the other, it is evident that with equal damage, and apart from watertight subdivision, the low-sided vessel would sink more speedily. In her, therefore, the pumping power might reasonably be increased, because her reserve of buoyancy was less. It will be understood, however, that I do not recommend this alternative mode of measuring pumping power for general adoption.

Another mode of measurement is to estimate the total horse-power available for pumping water out of a ship, and to express this as a fraction of the horse-power available for propelling the ship. This method ignores some very important considerations and some very erroneous conclusions which have been drawn from its application, to which reference will be made hereafter.

In practice neither of these methods has much weight. It is usual first to determine what use can be made, for pumping purposes, of appliances fitted primarily for use in connection with the propelling engines, such as the circulating pumps to surface condensers, the air pumps, the bilge pumps in engine-room, &c., or appliances fitted for special services, such as the fire-engine. Having made the fullest use of all such appliances, they are supplemented in certain cases by special steam pumps, and in all cases by hand pumps. No fixed rules are followed in arranging these supplementary appliances; but in each type of ship the special features are studied, and suitable arrangements made. For instance, in high-sided ships well subdivided, very frequently no special steam pumps are fitted, the circulating pumps, air pumps, fire-engine, &c., supplying what is thought to be sufficient power. In vessels of lower freeboard, with less reserve of buoyancy, and frequently using water-ballast, special steam pumps are fitted capable of pumping from the ballast compartments and the bilge.

When the reserve of buoyancy is very limited, as in the torpedo ram "Polyphemus," unusual pumping power is provided; but this is associated with iron ballast that can be detached when necessary in order to increase the buoyancy, and with remarkably minute watertight subdivision. When the engine power is very great, as in torpedo boats, enormous relative pumping power can be secured from circulating and air pumps, and auxiliary appliances are not needed.

These general considerations must suffice here. At the end of this paper I have given a more detailed description of general practice in the Royal Navy, and diagrams of the principal features in the pumping arrangements of a representative armoured ship. Further information on the subject will also be found in the Parliamentary Papers on "The "Loss of the Vanguard" (C. 1384 of 1876).

In the following table will be found examples of the pumping power of certain classes of war-ships, and of several modern merchant steamships. It is necessary, in looking through the figures, to remember that the efficiency of pumping power in a ship must bear some relation to the minuteness of her watertight subdivision, as well as to her engine power, displacement, and reserve of buoyancy. War-ships are much more minutely subdivided than merchant ships, and are therefore much safer from foundering, as they should be, considering the risks of action. As regards pumping power also it will be observed that war-ships are, as a rule, much better off than merchant ships. It is proper to add that of late years considerable extensions have been made in provision for the safety of merchant steamers, and that there is a prospect of further development. Watertight subdivision has been made more minute, cellular double bottoms are becoming common, and a large increase has been made in pumping power as compared with former practice. Appliances fitted primarily for use with the main engines are now adapted for pumping from the bilge in many ships; and special steam pumps, with auxiliary boilers, are not uncommon. The only other observation that need be made respecting the table is that it contains no information respecting the "reserve of "buoyancy" in the various types; freeboard and the reserve of buoyancy varying so greatly both in war-ships and in merchant ships that any fair comparison would be difficult. I have, therefore, simply described the character of each vessel named.

Class of ship.	Displacement. Tons.	Indicated horse-power of main engines.	Estimated power of all pumps in tons per hour.
1st class ironclad, not rigged	10,800	8,000	3,500
„ rigged	9,000	8,000	2,500
2nd „ „	6,000	4,300	1,400
Coast defence monitor	4,900	2,800	1,000
Torpedo ram	2,640	5,500	2,600
Unarmoured frigate	5,800	7,300	1,700
Troop ship	6,200	4,000	1,400

Class of ship.	Displacement. Tons.	Indicated horse-power of main engines.	Estimated power of all pumps in tons per hour.
Merchant ships :—			
Early type of ocean steamer	4,700	2,600	600
" "	7,300	3,300	400
Modern type	5,300	2,500	450
	6,700	3,400	900
	6,700	4,000	1,100
	9,600	6,500	1,200

NOTE.—The figures given in the right-hand column represent the power of the pumps under ordinary conditions.

Admitting that war-ships must primarily depend upon their watertight subdivision for safety from foundering, and that as regards pumping power they are better provided than the best equipped passenger steamers, it still remains an open question whether an increase in the pumping power should not be made. Some high authorities have pronounced against the present practice, and urged the desirability of increasing pumping power. For instance, the "Inflexible" Committee reported as follows:—"We note that the total pumping "power which the "Inflexible" will possess . . . . is capable of "throwing out 4,500 tons of water per hour . . . . The pumping "power is very disproportioned to the enormous extent of the leakage "to which a modern ship-of-war is subject in action. The 4,500 tons "per hour might be thrown out by 200 horse-power well applied, and "it appears to us to be a conclusion not to be admitted, except after "the most exhaustive inquiry, that a ship which has at her disposal "for motive purposes 8,000 horse-power, should not have more than "200 available for pumping purposes when she has been struck in a "vital part by ram or torpedo. We do not pretend to say how large "a proportion of the engine power could be made available, but we "think it right to draw attention to the subject as one demanding "grave consideration." (Page 14 of Report.)

Very similar recommendations have been made by the advocates of water-jet propellers; who have remarked that even if that system were less efficient for propulsion than screws, it would have a great advantage in making the same centrifugal pumps available for propulsion under ordinary circumstances, and for clearing the ship of water if damaged in action.

At the first glance such proposals are very attractive: but more careful consideration shows that serious difficulties would arise in attempting to carry them into practice. First, it must be noticed that to utilize this enormous pumping power, and bring it to bear upon any of the principal compartments, provision must be made for the flow of vast quantities of water from each of these compartments to the pumps. This would involve the construction of water channels

of very large sectional area, the cutting of large openings in bulkheads and other partitions, the fitting of very large sluice-valves, and other changes which must upset the ordinary stowage of the hold, seriously decrease the available space, and imperil the efficiency of the watertight subdivision. Furthermore, it must be remarked again, that the chance of losing a portion of the steam power when compartments are flooded is great, and that it is made the greater if large quantities of water are permitted to flow through more or less considerable lengths in the ship in order to reach the pumps. Nor is the risk inconsiderable which would follow any temporary derangement or stoppage of the pumps, supposing the water to be flowing into the pump compartments through the channels. It may be said that the sluices would then be closed, and watertight subdivision restored when pumping power failed; but surely it would be better to avoid the danger by trusting subdivision from the first, and stopping the inrush before setting the pumps to work, as explained in the earlier part of the paper.

If trial were to be made of these proposals for increasing pumping power, the hydraulic system would probably be the simplest that could be adopted; and then the turbine pumps would be placed in engine-room compartments which might themselves be flooded. An alternative method has been proposed by Lieutenant Makaroff, of the Russian Navy, by which a number of centrifugal pumps would be worked off the main shafts of screw steamers. The estimates of this gallant Officer are, I fear, much too sanguine, as to the quantities of water those pumps would be capable of throwing overboard; and I have seen no details of his plans for locating the pumps or leading the water to them. Nor does he appear to have given data as to the weight and space required for the pumps.

The recommendations of the "Inflexible" Committee are so guarded as to make criticism impossible, except on the general grounds stated above; but I cannot forbear from remarking that they appear to have placed an unduly high value upon pumping power, and to have overlooked some of the drawbacks incidental to its increase. If the view put forward in this paper is correct, and pumps are to be regarded as auxiliaries to watertight subdivision, coming into use after leak-stoppers are in place, then the power of dealing with very large quantities of water in extremely short times is not of the first importance. On the contrary, the work of clearing bilged compartments, or reducing the amount of water in them, can be proceeded with deliberately when the inflow has ceased and the stoppers are in place. And for such work the pumping power usually provided appears ample. A modern war-ship would be very badly damaged indeed if she did not retain the power of bringing a steam pump to bear upon the bilged compartments, when the stage had been reached at which pumping could serve any useful purpose.

A few general remarks as to the fitting of steam pumps may not be out of place. First and most important is the security for steam-producing power, given by minute subdivision of stoke-holds or by the provision of an auxiliary boiler placed high up. Next it is desirable

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SKETCH DESCRIPTIVE OF THE WATERTIGHT SUBDIVISION, PUMPING AND DRAINAGE

REFERENCES.

A . . A . . Steam pumps for pumping Double Bottom and Main Drain pipe.

B . . B . . Main suction pipe connected with each of the Steam pumps.

C . . C . . Stand pipes connected with the Main suction pipe and communicating with the several compartments of the Double Bottom.

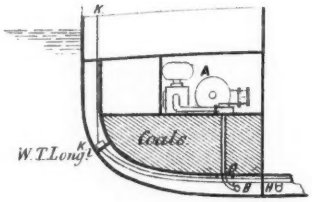
D . . D . . Non return valves in suction pipe.

E . . E . . Stop valves „ „ „

F . . F . . Discharge pipe from Fore Steam pump.

G . . G . . Main Drain cisterns.

SECTION THROUGH AFTER STEAM PUMP



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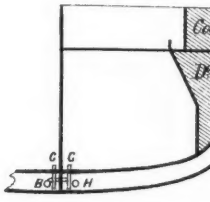

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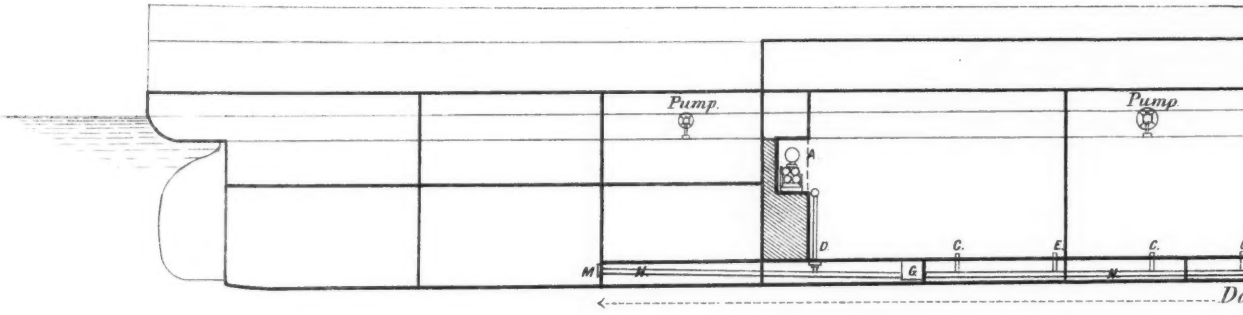

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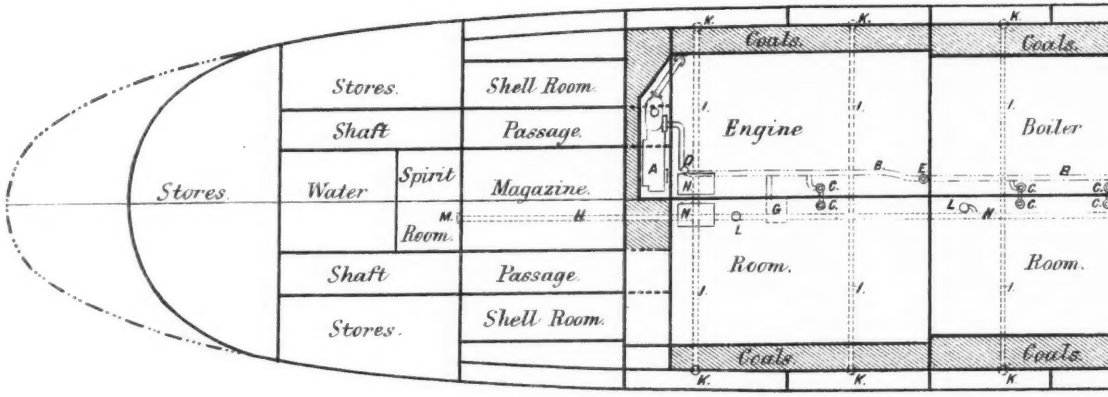

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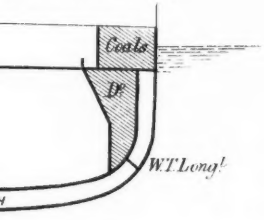
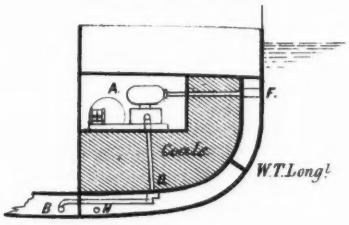
DRAINAGE ARRANGEMENTS AS ADOPTED IN A FIRST CLASS WAR SHIP IN H.M. SERVICE.

ECTION THROUGH
ND PIPES. (AMIDSHIPS)



SECTION THROUGH
FORE STEAM PUMP.



H.. H.. Main Drain pipe.

I .. I.. Branch Drain pipes for conveying water from above *W T* Longl.. to Main Drain pipe.

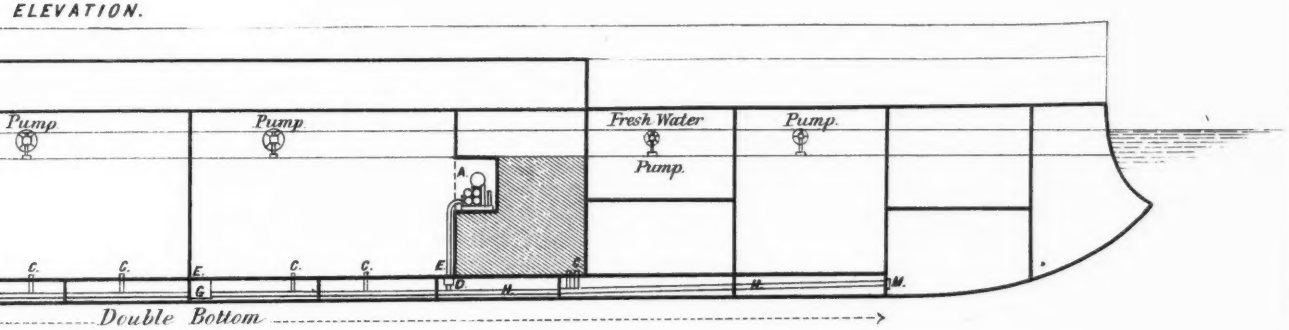
K.. K.. Screw-down valves fitted in the upper ends of Branch Drain pipes and worked from deck above *L W L.*

L.. L.. Screw-down valves in Main Drain pipe for regulating admission of water to the Main Drain.

M.. M.. Sluice valves in ends of Main Drain pipe.

N.. N.. Circulating pumps connected with Main Engines.

ELEVATION.



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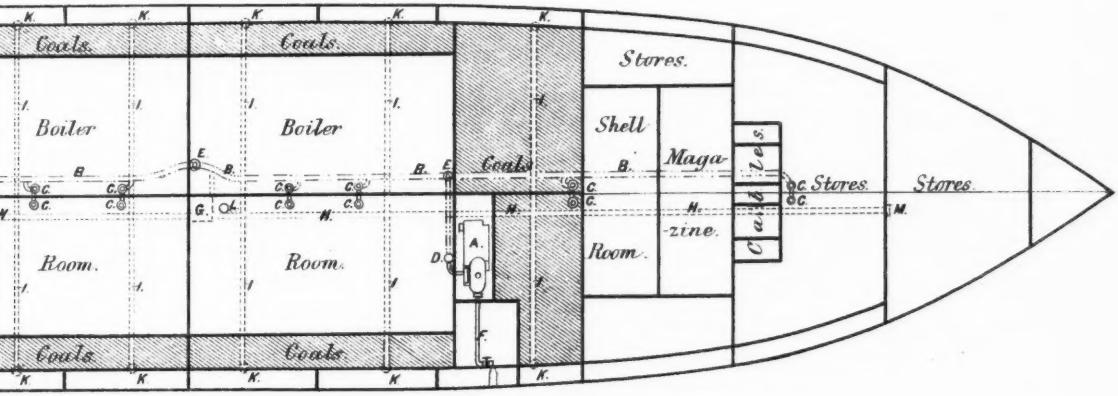

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to place the engines by which the pumps are driven as high as convenient, in order to keep the cylinders from being immersed; and the pumps themselves low down, so that they may command the best possible supply of water. All means for controlling the valves, suctions, &c., of steam pumps should be placed high up, and in positions easy of access. Lastly, as already explained, careful provision should be made for the free flow of water from damaged compartments to the pumps.

The steam pumps generally used in Her Majesty's ships are either centrifugal or force pumps. In central citadel ships, carrying coal on their armour-decks, provision has to be made for pumping water (with which coal will be mixed) from the coal-spaces. The form of pump preferred, after careful trial, for this special service is a simple steam jet, or "ejector" (Friedmann's). It is much more wasteful of steam than a centrifugal pump, but is extremely simple, easily started, very difficult of derangement, and occupies little space. Supposing the main boilers to keep steam, an enormous quantity of water could be ejected by apparatus of this kind, which could, moreover, be distributed over the various compartments. It is conceivable, in fact, that each important compartment might be dealt with independently by means of its own ejectors if desired, and no necessity be felt for leading water to the engine-room compartment. It will be understood that I do not recommend such a method, but simply mention its practicability in association with perfect watertight subdivision, and a simplification of the drainage.

Attention may now be directed to the *actual uses* of pumps in modern ships. These may be conveniently grouped as follows:—

(1.) *The ordinary or routine work of clearing small quantities of water from the bilges; supplying fresh water to cisterns, baths, &c.; providing for wash-deck service, &c.*

All this work requires very moderate power in the pumps, and can be done at leisure. It is performed in Her Majesty's ships by the several hand pumps; and by small auxiliary steam pumps, usually placed in the engine-room.

A very convenient method of making a limited number of pumps capable of pumping from the numerous compartments of the hold, is found in the "main drain pipe" (see Plate IV) which runs longitudinally throughout the length of the double bottom at some distance below the inner skin. This pipe has cisterns fitted to it at certain stations, and it communicates with the various compartments by means of special valves, which permit water to pass down from the compartment into the main drain, but not to pass up from the main drain into any compartment. Supposing water to be in any compartment, all that requires to be done in order to bring it under command of the pumps is to open the main drain valve; the water then flows along the main drain to the cistern, and is then pumped overboard. This brief explanation will be better understood by reference to the diagrams.

No explanatory remarks are needed as to the fresh water and wash-

deck services; beyond the statement that a separate system of pipes connects a small steam pump and a Downton's pump with the fresh water tanks in the hold, and enables it to distribute the water to any part of the ship where it may be required.

(2.) *The special work of filling or emptying spaces in the double bottom when they are used for water-ballast.*

In most ships-of-war water-ballast is seldom used; and hand pumps are trusted to deal with the comparatively small quantities of water needed. In each compartment of the double bottom there is a "stand-pipe" to which the suction of one of the pumps can be attached, and thus the compartment can be either filled or emptied. There are classes of ships, however, with large coal supplies, in which the use of water-ballast is more common, and provision is made for rapidly filling or emptying the whole of the double bottom. Steam pumps are fitted in such cases, capable of pumping out 1,000 to 1,200 tons an hour. These pumps are attached to another longitudinal pipe placed in the double bottom, termed the "main suction;" and connections can be opened between this suction pipe and the several stand-pipes. Although fitted primarily for dealing with water-ballast, these pumps can be made available for pumping from the bilge and the main drain in case of serious damage.

(3.) *The work involved in dealing with larger quantities of water which may enter compartments damaged in action.*

This is the critical case to which considerable attention has already been devoted. Speaking generally, it may be said that every pump in a ship, whether hand or steam, can be brought to bear in such an emergency; but that manning hand pumps is of no service whatever, as far as the safety of the ship is concerned. The real dependence must be placed in the various steam pumps when attempting either to keep down a small leak, or to pump out quickly large quantities of water from damaged compartments after the leak has been "stopped." According to ordinary practice most of these steam pumps would be located in the engine-rooms. The chief are the circulating pumps, and the air pumps (if fitted to draw from the bilge); but there are also the "fire-engine," the "bilge pumps" worked off the main engines, and auxiliary fire and bilge pumps. As already mentioned, the "double-bottom pumps" (if fitted) are also available, and in certain special ships "ejectors" are used in addition.

One most important condition in the proper action of these powerful pumps is that there shall be a full supply of water to them. Since most of them are located in the engine-room, to fulfil this condition it is necessary to form good water channels from all the principal compartments of the hold to the engine-room. The main drain is of some service in the matter, but it alone would not suffice. Formerly it was the practice to fit large sluices in all the principal transverse bulkheads, so that water could flow to the circulating pumps along

the top of the inner bottom. This involved, of course, partial flooding of all compartments between the damaged one and that where the circulating pumps were placed: an objectionable feature, not unattended with risk. Now that main suction pipes as well as main drains are fitted, the two channels can be made available in case of emergency, and the necessity for sluices is avoided. But even in these cases it would be too sanguine to hope that the full power of the circulating pumps could certainly be exerted in all cases. This portion of the pumping arrangements of ships requires close attention in order that the actual power of the pumps may approach the estimated—since estimates usually assume no failure in the supply of water.

(4.) *The work connected with the "fire service."*

The system of mains, branches, and nozzles for hose-connections by which water can be distributed to all parts of a ship in case of fire is too well known to need explanation. This fire service is usually connected with the "fire-engine" proper, with auxiliary fire and bilge pumps, and with the hand pumps. Under ordinary conditions the auxiliary steam pumps and the hand pumps would be used; in time of need the fire-engine would also be in operation. Besides pumping from the sea through the fire service, these steam pumps can pump from the bilge and the main drain.

Formerly it was a common practice to furnish the fire-engine with its own boiler, placed high up in the ship, in order that a steam pump might be available even when the stoke-holds were flooded. This practice had much to commend it when subdivision of the stoke-holds was much less minute than at present; but it has not been continued in recent ships with four separate stoke-holds, from either of which steam can be furnished to all the auxiliary engines driving steam pumps. A variation of former practice has been introduced into a few of the older ships, and into some foreign ships: this consists in fitting a Shand and Mason or a Merryweather steam fire-engine, capable of having steam raised in the boiler in eight to twelve minutes, and of throwing 750 to 850 tons per hour to a height of 20 to 30 feet.

In conclusion, I would venture to remind naval Officers that they have opportunities of becoming familiar with the details of the pumping and drainage arrangements of any of Her Majesty's ships, by studying the drawings and descriptions to be found on board each of these vessels. The knowledge thus obtained cannot fail to prove useful, and this paper will have served its purpose if, in any measure, its serves to increase the attention given to the subject by naval Officers.

Mr. RAVENHILL: I much regret coming here as a visitor to find so sparse an attendance of naval Officers, who must be deeply interested in the question that Mr. White has brought under our notice this evening. I am sorry to say that I am sufficiently in the sere and yellow leaf to remember the wooden screw steamships in Her Majesty's Navy which went away to represent England's honour during the Crimean War, and I have no hesitation in saying that according to our present notions and the information that we now possess, they were such as men of the

present day would scarce care to be sent afloat in on a similar service. Science has made rapid strides, and the question brought under our notice this evening is one of structural construction against pumping power. It simply resolves itself into these few words. When you had a wooden ship to deal with you could do but little; and I need only quote the loss of the "Amazon" through collision on her first voyage down the Channel, when, as many of you know, she sank in comparatively a few minutes. We have since those Crimean days seen the Admiralty officials when dealing with the present materials which they have been called on to introduce into the Service—more particularly perhaps iron, because although steel is now being used it is comparatively a new material—to subdivide their ships into compartments in the way which is represented on the diagram before us; and it must have great effect both on the Officers and also on the crew to feel that, under any circumstances, if they have to go under fire there is underneath them a structure which will not sink. Our ironclads (as shown to us to-night) of the newest class are of that construction; the great point there can be no doubt is the keeping those vessels in the effective condition they are turned out in by the dockyard Officers from designs furnished to them from Whitehall. All the several fittings should be kept in the most perfect order, and the crews should be drilled so that in the event of emergency every man shall be at his post, and all the appliances provided taken advantage of. It is, perhaps, only those who have seen or have been present when the services of men are required on a great emergency who can appreciate the result of this. It once fell to my lot to hear the alarm fire-bell rung in a dockyard, and it certainly was a wonderful sight to see how everybody fell into his place, and how quickly that fire was got under. The same thing is necessary on board men-of-war. If an accident occurs, and a large leak should unfortunately take place, the men fall in almost at the boatswain's whistle, and the danger is a mere nothing. I cannot help feeling, and I believe you will agree with me, that in that respect we have gained as nearly as possible all the perfection that science can hope to attain to; and I think there is a deep debt of gratitude due to those who have had the scheming of these things, and have had to carry them out, and have thereby placed the men of the Royal Navy in what I hold to be a secure position. Great advance has also been made in our commercial marine. In that we are all interested, because any of us may be called on to-morrow to cross the Atlantic or go to some of our distant colonies; and I am certain of one thing, that if the Navy leads the way in the security of their ironclad fleet, and of the lives of those on board, our commercial marine will follow. Our commercial marine is, as you know, under no one head, no one Board, such as the Navy; but there is a Board of Trade and a "Lloyd's Register," and the underwriters will, as far as they can, take the benefit of any improvements suggested and carried out in the Royal Navy to reduce their risks, and in reducing their risks they will reduce ours. Mr. White has shown us the minute details of the pumping arrangements of one of our first-class ironclads. There is one more point which I will allude to—I speak with all deference—and shall be glad to be corrected; but I think it is a strong point that structural construction is far superior to any pumping power, and it is this: that supposing the vessel which you see there, should get on the rocks and her bottom should be most extensively injured, and that those lines of fore and aft pipes which he has drawn your attention to, connected with the different pumps, become seriously injured, the structural condition of that ship would save her. There can be no doubt that it is a point which has deserved all the attention it has received, and I am glad to find that it has been well thought over and well worked out.

Captain LONG, R.N.: As one of the Officers having the advantage of that instruction which Mr. White has called attention to, and which he is very well fitted to impart, I should like to say a word or two. When we look at that plan, we cannot too much admire the way in which our naval architects have worked out the problems submitted to them. Twenty-five years ago I was midshipman in one of the former ships of the Navy. She sprang a small leak, and would have sunk if she had not been run ashore with her bow 11 feet deep in the mud, so that her engines could keep up forty-five revolutions. That ship was the "Royal Albert," and her case shows the strides that have been made at the present day. The water going into that ship was 5 tons a minute, 300 tons an hour; and I suppose she was

a vessel about the tonnage of that type of merchant steamer to which Mr. White referred, with a tonnage of 4,700. We see that that vessel there can pump out more than the "Royal Albert" was taking in. I was once called upon to report as to the pumping power of a ship I was in, and I reported that although the provisions for throwing out water were ample as to the principal compartments, yet they did not extend to some of the smaller ones. I am not so sure that in some of these composite built vessels, which are only divided into a few compartments, a difficulty might not arise from great change of trim in the event of a large leak occurring in one of the end compartments. There is one question I should like to ask, namely, whether the deductions we have heard made are meant to apply to an explosion such as would be caused by 250 lbs. of gun-cotton, and also if Mr. White can give us any idea as to what proportion of the horse-power would be absorbed in throwing out the water? I take it the larger proportion of water would be thrown out by the circulating pump, but would it be possible to form an opinion as to what deduction would be made from a ship's steam power? You would not only want to be throwing out water, but also you would want to be providing against emergencies that might arise in naval actions.[1]

Mr. WHITE: With regard to Captain Long's question as to the fraction of the horse-power which is taken up in throwing out water, I may say that very commonly from one-half to two-thirds of the total pumping power of a ship is to be found in the circulating pumps; and, of course, so long as the circulating pumps get their water from the bilge for condensing purposes, you do not lose in anything like the same proportion for propelling. The question of what loss of speed would be involved if you brought all the pumping power to bear is, of course, a question no one can pretend to answer. As to Captain Ericsson's results, I should like to see the trials repeated on this side of the Atlantic, or at least in the presence of some of our own Officers; I should like to see an English report, or a report which is not in the nature of an advertisement of its capabilities. I do not say the invention is not capable of doing all that is claimed; in fact, I know nothing about it, except what I read in the newspapers. But we know perfectly well that when these great inventions are brought closer home some of their qualities at least frequently become lessened. As to the composite ships, of course I have not dwelt upon them in the paper. I excluded the small-armed ships, which would exclude all the composite ships. Composite ships are, as respects the toughness of their skins, the difficulty of penetration, and the liability to severe leaks, very much in the same condition as wooden ships. They compare badly with wooden ships in one respect, having no fillings between the floors; but still the skin of an ordinary composite ship of the very smallest class would in its resistance to penetration by grounding, &c., be much stronger than the thickest outer skin of the largest iron ship; that is to say, we realize the necessity, in ships which have only a thin iron or steel skin, of providing something inside in the form of watertight subdivision. It would not be desirable to try to increase the local strength of the skin itself, that would be ruinous in a structural point of view, therefore we provide for it by internal subdivision. Mr. Ravenhill mentioned the possible damage to the drain and suction pipes and the consequent loss of pumping power. Of course, in cases of grounding, that may be so; but so long as the damage is confined to the part of the bottom below the bilges, I do not think we have the worst to fear. We have there an amount of subdivision and strength which is not at all comparable to what is to be found above on the wings of the ship. With respect to the division of merchant ships and the increase of their pumping power, I think there are gentlemen here who, if they would, could give us much more information on that subject. I have been careful in the paper itself to speak of the very great attention that has been recently given to that subject in the mercantile marine. There is an increase in extent of subdivision as well as an increase of pumping power—the two things have gone

[1] I wish to add that I concur in Captain Colomb's view as to the avoidance of watertight doors, when possible; and it has been suggested that Officers in command should be furnished with the capacity of the several compartments in their normal state.

together—which is scarcely realized by the travelling public; and in some of those vessels which are now leaving the slips, and which will be running in the coming summer in the Atlantic trade, there is no doubt the passengers will have a guarantee of safety by minuteness of subdivision which they have never had before. There is in some of these large steamers a superiority with regard to watertight subdivision to anything that has yet been planned in the mercantile marine. I only regret that it should have fallen to my lot to mention this instead of some other gentleman who might have spoken with more authority on the subject.

The CHAIRMAN: I am sure we are very much indebted to Mr. White for the trouble he has taken in bringing this subject before us. Some of us who in our younger days commanded the simple old-fashioned ships of that time look with perfect dread at the complicated machines which the Officers of the present time have to command. When we think of the numberless cocks and pipes, and pumps and sluices, and compartments, and other machinery that have to be attended to, it is really surprising how any man can thoroughly master the details of the vessel he commands. That it is most important that he should do so is very evident, and I think some of us may remember the very curious case which happened when the first wooden ironclads went to sea. On one occasion in the Irish Channel one of these vessels was in a very heavy breeze, and they could not make out why the more they pumped the more she seemed to leak. Eventually it turned out that some of the cocks were turned the wrong way, and instead of pumping the water out they were actually pumping it in. I only mention this to show how essential it is that the naval Officers of the present day should avail themselves of every opportunity of making themselves masters of all the complicated details on board their ships. It only remains for me to thank Mr. White, in your name, for having brought before us this very interesting and important subject.

Friday, February 18, 1881.

SIR RUTHERFORD ALCOCK, K.C.B., D.C.L., &c., &c., in the Chair.

A VISIT TO KULDJA AND THE RUSSO-CHINESE FRONTIER IN 1880.

By E. DELMAR MORGAN.

BY way of introduction let me attempt to give an outline of the intercourse between Russia and China from its commencement to the present day. As these remarks must necessarily be brief, I will pass as lightly as possible over the ground. A study of the relations of China with the rest of the world is more particularly interesting at the present time, when Eastern affairs are so unsettled.

Unlike the Western Powers, France, England, and the United States of America, the intercourse of Russia with China has always been overland, and has been guided by other than purely commercial considerations. Questions of territorial rights, extradition, and the Russo-Greek Church have, together with trade, formed the basis of treaties and negotiations between the Colossus of the North and the Middle Kingdom. The first attempt to regulate their international relations dates back to the reign of Ivan the Terrible, who sent in 1567 two atamans or Cossack chiefs to explore the Trans-Baikal countries. They returned and reported to the Tsar that they had crossed Mongolia and all the country beyond Siberia, and had even been to Peking, but that the Emperor of China would not receive them because they brought no presents. This proves that the Chinese regarded Russians as vassals—an idea which seems to have been perpetuated in China long afterwards, and with respect to other nations. Thus Ambassadors were refused an audience of the Bogdo-Khan because they would not *ko-tow*, *i.e.*, prostrate themselves. In 1793, when Lord Macartney, the British Ambassador, ascended the Peiho on his way to Peking, a flag was hoisted on his junk with the following device in Chinese characters: "This is an Ambassador "bearing tribute from the English nation." An instance of more recent times was related to me by a Russian Officer and eye-witness. When the country around Issyk-Kul was being annexed by his Government in 1856–57, and detachments of Chinese troops occupying it were taken prisoners, their commanding Officer, although completely helpless and at the mercy of the Russians, insisted upon all formalities prescribed by Chinese etiquette being observed. The interpreter, before communicating the disagreeable fact of their being prisoners of war, had to prostrate himself and ask permission to make known

the words of the "barbarian," referring to the Russian Officer. With the conquest of Siberia the relations of Russia with China acquired greater importance, and several efforts were made to cultivate a closer acquaintance. But it was not till 1644 that Michail Poyarkof with his companions in arms established themselves on the River Amoor. Three years later Khabarof, a Cossack chief, founded the fort and colony of Albazin on this river, which he explored to its mouth, overcoming all resistance of the Toungoussic natives. In 1667, however, a large Chinese Army appeared before Albazin, and summoned it to surrender. The garrison withstood a two years' siege, and were at last compelled by famine to yield. But the richness of the country attracted others from Siberia, and Albazin was rebuilt. In 1685 it was besieged a second time by a Chinese Army numbering 15,000 men, with 100 pieces of artilley. The garrison again made a valiant defence, but in the end were obliged to capitulate conditionally upon being allowed to withdraw to Nerchinsk. Twenty-five of their number, however, were sent prisoners to Peking, and among them a priest called Leontieff. These laid the foundation of the Russian colony at Peking, and of the Russo-Greek ecclesiastical mission which has been the means of throwing so much light on Chinese history and literature. But to return to Albazin, for it is around this fort that interest centres towards the end of the seventeenth century. The disaster which befell the Russian garrison in 1685 by no means terminated its history, for that same year it was rebuilt by Tolbuzin, a Cossack, assisted by Beuthen, a German exile. For the third time the Chinese advanced against it, their army this time being supported by a flotilla. In the siege which followed Tolbuzin was slain, and the command devolved on Beuthen, who defended the place for two years and then voluntarily evacuated it. The history of Albazin proves its importance to the Chinese, who regarded the whole basin of the Amoor as their territory, and even claimed the country as far west as Tobolsk. They knew too that, till Albazin were destroyed, the constant incursions of Cossacks and hunters, generally causing bloodshed, would continue. The Government of Moscow, though at too great a distance from the scene of action to make its authority felt, could not but sympathise with the bold adventurers who were pioneering Russian colonization and commerce to regions so rich and promising, and they endeavoured to second their efforts by opening diplomatic relations with the Chinese Government. Their first mission under Baikof, after encountering every imaginable difficulty, reached Peking in 1653. He submitted to the humiliation of the *ko-tow* and presented gifts to the Bogdo-Khan, but was completely unsuccessful in obtaining concessions. Others who followed Baikof, although well received by the Emperor Kang-hi, did no better. In 1676, Spafari, a translator at the Foreign Office in Moscow, was charged with a mission to Peking. He was accompanied by the Jesuit Verbiest as dragoman, and it is worthy of notice that, so far from being aided by the learned father, he attributed his failure to his presence; indeed the Jesuit missionaries in China, down to their expulsion in the beginning of the eighteenth century, were always accused by Russia of systematically

opposing her efforts to enter into close relations with the Court of Peking. In 1686 the Government of the Tsar Alexis Mikhailovitch renewed the attempt to negotiate with China, entrusting the task to Councillor Golovine. His instructions were to conclude a treaty at all costs, and particularly to define a frontier. Golovine was met by the Chinese Plenipotentiaries at Nerchinsk. They were accompanied by a large army, while he had only a few hundred soldiers. Negotiations on points of ceremonial occupied as much time as political questions, and though Golovine showed skill and energy, he was obliged to yield, and in August, 1689, the first international treaty between Russia and China was signed.

By this treaty the River Amoor and all the countries watered by it were ceded to China. Russia consented to the destruction of Albazin, and the River Gorbitza was made the boundary between the two Empires. Russia lost a magnificent province, and attributed her diplomatic defeat to Fathers Gerbillon and Pereira, who were attached to the Chinese Embassy; but the Treaty of Nerchinsk was never carried out, and no benefit resulted from it. In 1692, the young Tsar, Peter I, sent a German merchant, Isbrandt Ides, on a special mission to Peking, with orders to demand an execution of the Treaty of Nerchinsk and the right of building a Russian church at Peking. He was, however, completely unsuccessful, the mandarins refusing to listen to any proposals; but from the commencement of the eighteenth century a more friendly spirit prevailed between the two Governments. About this time the Russian ecclesiastical mission was established at Peking, and the first of its Archimandrites, Illarion, appointed. His successors have from time to time been renewed by the Holy Synod at St. Petersburg. Peter the Great was not slow to avail himself of the more favourable disposition evinced by the Emperor of China, and in 1719 he sent Captain Ismailof with twenty-five dragoons, accompanied by Lange, a German engineer, who acted as his secretary. Their instructions were to negotiate a new treaty, that of Nerchinsk never having been executed. The illustrious Emperor Kang-hi received the Russian envoy in solemn audience with due honour, and said:—
"Nothing in the world should disturb our friendship with Peter the
"First. What reason have we to seek a quarrel? The Russian
"Empire is distant and cold; if the Bogdo-Khan were to send his
"armies into Russia they would all be frozen. On the other hand, if
"the Emperor of Russia sent his troops against the Bogdo-Khan they
"would equally perish to no purpose, for they are not accustomed to a
"warm climate. Supposing," he added, "one of us were to get the
"better of the other, what profit would there be since each Empire
"already possesses so much territory?" Notwithstanding this favourable reception, Ismailof made no progress in his negotiations, and all he succeeded in doing was to obtain permission for the erection of an Orthodox Russian church at Peking, and for a Russian consular agent to reside there; but he could not obtain a recognition of the right of his Government to pay and maintain their own Officer in China nor to establish agents in other parts of that country. Ismailof left Peking in 1721, his companion Lange remaining in the capacity of

Russian agent, but receiving his salary from the Emperor of China. An account of this, the first Russian diplomatic agency in Peking, would be extremely interesting did time allow of its being included in this sketch. Suffice it to say that it proved generally the powerlessness of the Bogdo-Khan, and that he was as much the tool then of the literary, mandarin, and courtier classes as he is to this day, with this difference, that whereas in Lange's time the wisest and best of the Manchu sovereigns occupied the throne, now this dynasty is represented by a mere puppet.

Peter the Great was obliged to confess that making treaties with China was a more difficult matter than he thought it to be, and it was reserved for his successors to accomplish the task. The Treaty of Kiachta, concluded in 1727, by Count Radislavitch, envoy of the Empress Catherine I, marks an important epoch in international relations between Russia and China. For upwards of a century it served as the basis of commercial and diplomatic intercourse between the two Empires, inaugurating a more conciliatory spirit on the part of China, and a desire to maintain and develop intercourse with Russia. This change was due to events happening about this time; China was engaged in war with a Mongol nation, the Dzungars, occupying the Valley of the Ili, or Kuldja, and she sought the alliance of Russia, promising in return to protect commercial relations. But as soon as the war ended with the annihilation of the Dzungars, matters again took an unfavourable turn for Russia. Moreover, the refusal to surrender the Dzungar Chief, Amursana, who had sought refuge in Russian territory from Chinese vengeance, angered the Government of Peking, and so many restrictions were placed on Russian commerce, as practically to close the Kiachta trade for some years, from 1762 to 1769, while the members of the ecclesiastical mission at Peking were even thrown into prison. The embassy of Count Golovkine, in 1805, was the last of the efforts made by Russia to develop commercial relations by sending diplomatic missions. From that year to 1851, *i.e.*, to the conclusion of the Treaty of Kuldja, the interchange of official communications between the two Governments took place through the medium of the authorities at Kiachta on the one side, and those at Urga on the other. But this long lapse of time was not wasted by Russia. Abandoning for the while all idea of developing her trade with China, she concentrated her energies on the task of studying the internal condition, prosperity, and resources of that country. To this period belong the scientific expeditions of Timkofsky, Fathers Hyacinth and Palladius, Sytchefsky, Kovalefsky, Zakharof, and Vassilief, whilst Middendorf's explorations in Eastern Siberia once more drew attention to the imperative necessity of reconquering the Amoor. International relations, however, soon entered a new phase. While England and France were extorting concessions by armed force, Russia skilfully turned these to the best account, and obtained equal advantages without having recourse to arms, concluding four great international treaties with China in the short space of eleven years. By the first of these, the Treaty of Kuldja in 1851, the province of Kuldja was thrown open to Russian trade, and the

right was acquired of appointing consuls in the two towns of Chuguchak and Kuldja. The question of extradition was at last satisfactorily and conclusively settled. Henceforward only "criminals" who sought refuge in either territory were to be given up, and not an entire people. The Treaty of Aigun, signed in 1858, ceded to Russia the left bank of the Amoor, from the Aigun to the sea, and guaranteed commercial privileges to subjects of both States on the Oussouri, Amoor, and Soungari Rivers. A fortnight after its signature, Count Poutiatine (whom I have known many years), at Tien-tsin, by firmness and tact, prevailed on the Government of Peking to accede to his proposals, while Lord Elgin and Baron Gros were imposing theirs by force. The Treaty of Tien-tsin at once placed Russia upon an equal footing with the Western Powers. Finally, the negotiations at Peking, in 1860, with General Ignatief, confirmed and extended the Treaty of Tien-tsin. Since 1861, a Russian representative has continued to reside at Peking, and in 1869, the Chinese Burlinghame embassy visited St. Petersburg.

For the above sketch, I am largely indebted to a pamphlet by Professor Martens, of the University of St. Petersburg, entitled "*Le "Conflit entre la Russie et la Chine*," and I will only add what most people are aware of, that in 1879, a Chinese embassy visited St. Petersburg to arrange for the retrocession of Kuldja. A treaty then made remains unratified, and the Chinese representative, Chung-how, narrowly escaped with his life at the hands of his incensed countrymen.

Rumours of a Chinese invasion caused no little stir in Turkestan in the spring of 1880. News was brought of a concentration of Chinese troops at Chuguchak, and when orders were received from headquarters to raise an additional Cossack regiment, veterans who had fought on many a field were heard to say that never had there been such a scare even in the time of Nicholas. Among Russians of all classes war with China was looked upon with disfavour. Two successive years of bad harvests caused by droughts followed by severe winters had produced much distress, and every available hand was required to help to repair the ravages and fill empty garners. Moreover, there was hardly a Cossack family but had some member on the active list serving on the frontier, who might fall a victim to Chinese barbarity. Mingled with these gloomy forebodings, was the serious prospect of the tea supply being cut off, and lamentations were very general. Orders, however, must be obeyed, and as only a few days were allowed for preparing the necessary contingent in each stanitsa, there was not much time for outward expressions of concern. I happened to be staying at a "stanitsa" or Cossack village in Semirétchia at this time, and witnessed the preparations for the equipment of a troop of this irregular cavalry. The Cossack force has been estimated at 140,000, but I have unfortunately no data for verifying this statement. There would seem to be no practical limit for increasing it indefinitely as long as there are new colonies capable of being converted into military settlements, holding their land by military tenure. It may be well to remember that the first Cossacks were those

of the Don in South-Eastern Russia. They were vagrants, outlaws, and dissenters from Great Russia, who upon the disintegration of the Tartar hordes, established themselves in independent communities, and after being reinforced by all kinds of wild spirits, were enabled to make war upon the Turks, whom they drove out of Azov in 1637, their only bond of union being the Greco-Russian faith, a profession of which was necessary to admit them into the fraternity. Up to the time of Peter the Great they were not interfered with, but from 1718 they were gradually brought under authority, and compelled by the Tsar to take up agriculture, which they had previously held in contempt. Some are of opinion that the first Cossacks came from Circassia, and though this opinion is not without foundation, it is more probable that their origin is as I have stated. Yermak, conqueror of Siberia, and his followers were Cossacks of the Don; from the Don Cossacks, too, originate those of the Volga, the Terek, the Oural, and Siberia; and from the Siberian Cossacks those of Trans-Baikalia, the Amoor, and Oussouri, as well as the Semirétchian Cossacks, with whom we are more immediately concerned in this paper.

Cossacks at one time enjoyed a considerable amount of liberty, when upon them devolved the arduous task of protecting the frontiers of Russia both in Europe and Asia from Turk and Tartar, Kalmuk and Kirghiz, and "free as a Cossack," passed into a proverb in Russia. They elected their own Officers, the ataman (derived from *ata*, father) or chief who managed local affairs, and essaouls or commanders of sotnias, whom they obeyed in the field, but when the period of active service was over, the Officers resumed their places as simple Cossacks. Their land was parcelled out into arable, pasture, and woodland, of which each member of the community received a portion, and held it in perpetuity. But their rights and privileges were encroached upon by every succeeding sovereign; only a few years ago the Cossacks of the Oural had their privileges taken away, and because they resisted were beaten and expelled from their homes. I saw and spoke with some of these unfortunate men, numbering it is said about 70,000, anxiously expecting some amelioration in their fate, which condemns them to be separated from their belongings, and compels them to maintain themselves as best they can. This is not the place to speak of the Cossacks and their rebellions. It is only incidentally in treating of the military resources of Russia in Turkestan that it is important to glance at the Cossacks who compose the whole of the cavalry. While at Omsk I was shown over the building set apart for the internal administration of the Siberian Cossacks, a young Officer kindly acting as my cicerone.

As soon as a boy is born his birth must be registered in his village; when old enough to ride, his military education begins, and among the characteristic sights at all the villages I passed were troops of these urchins mounted on rough, bare-backed steeds.

At 17 the youthful Cossack becomes liable for home duty, and when he has attained the age of 19, he must be prepared to join and accompany his *sotnia*, or regiment, whithersoever it may be ordered. After two and a half years of active service he receives a short furlough, but

may be required to join his regiment at any time until he has served fifteen years, when he is placed in the reserve for home duty. At the age of 55 he is freed from all further service. Every Cossack provides his own horse, arms, and accoutrements, while carbine and ammunition, rations and forage, during a campaign, are supplied by Government. At this building at Omsk, plans are prepared of all the Cossack lands, and disputes among themselves are arranged without having recourse to the law courts. A Cossack regiment numbers 750 men, or, including supernumeraries, 850, and is divided into companies or sotnias of 100 men, commanded by Officers of the rank of Captain. These, again, are divided into half sotnias and tens. The privilege of electing their own Officers was first taken away from the Cossacks in Alexander the First's time. He placed them on a level with line regiments, in which rank confers hereditary nobility, thus destroying the democratic organization characteristic of the ancient Cossacks. This innovation has been still further developed during the present reign, and the names of those commissioned to the newly enrolled 2nd Semirétchian Regiment seemed to me to have a Teutonic rather than a Slavonic ring, whilst their owners, whose acquaintance I afterwards made, afforded a marked contrast in physique and appearance to their men, looking oppressed in their "papakhas," or great sheepskin hats. As to the efficiency in time of war of the Cossacks, military critics differ, and regulars have not a good word to say for them, but this is doubtless in part attributable to jealousy, for the command of a sotnia is a much coveted post by young guardsmen and other adventurers who seek their fortunes in Turkestan. I myself can testify to the high state of discipline to which they are capable of being brought. In the Kizim Chik Valley, at the northern foot of the Borokoro, I visited the camp of a sotnia holding an advanced position towards China. Here all the arrangements to guard against surprise, and to provide for the health and comfort of the men, were admirable, and did great credit to their commanding Officer, a Pole. Some, however, are opposed to strict discipline for Cossacks, looking on them merely as irregular cavalry. But, in any case, Cossacks of the present day, armed with Berdan carbines, are altogether different troops to what they were when Yermak and his followers overran Siberia, or even a quarter of a century ago, and the part they took in the conquest of Turkestan showed that they generally possessed the qualifications so very desirable in a guide corps.

It is a mistake to suppose that the conquests of Russia in Central Asia are barren. This is not the view taken of them by those Russians most competent to form a true opinion on the subject. They have added to the security of the Asiatic frontier, by putting an end to disturbances in the steppe. They have opened the way to the markets of Central Asia, and given increasing political weight, adding enormously to the power and rank of Russia among the nations of the world. The few millions spent on military expeditions are not worth placing on the other side of the balance.

Of the inhabitants of the military province of Turkestan about half, numbering a million and a-half, are Kirgbiz, a pastoral people, of

mixed Aryan and Mongolian race, with nomadic habits. The task of assimilating this people with the Russians, rendered possible only since the downfall of the three independent khanats (Bokhara, Khiva, and Kokand), has made some progress of late years, especially since 1867, when, on the recommendation of the so-called Steppe Commission, their institutions were remodelled; their hereditary aristocracy or class of sultan-rulers, claiming descent from Jinghiz Khan, deposed from authority; tribal distinctions discouraged, the whole territory, comprising a superficies of about 400,000 square miles, divided into provinces, districts, and cantons, and electoral chiefs and elders introduced into the several cantons. It is not our purpose to examine these changes, which were only provisionally adopted, but are likely to become fixed. Suffice it to say, however, that the apparent result is, on the whole, favourable, as far as tranquillity and security to life and property are concerned. Occasional raids and forays occur in more remote parts of the frontier, where the brigands try to elude pursuit by escaping into Chinese territory, but the authors are generally pursued and, sooner or later, punished. For the present, the natives of Turkestan are exempt from military service, though some advocate their being placed on an equal footing with other subjects of the Empire in this respect as they have been in all others. The authorities, however, have decided, doubtless wisely, not to make soldiers of them. M. Veniukof, in his review of the Russian frontiers of Asia, says that a militia composed of Kirghiz would do more harm than good in actual warfare. This may be too strong an opinion. At all events, they are a robust, hardy race, with instincts of a warlike, or rather predatory nature; excellent horsemen, though perhaps not so good as their ancient foes the Kalmuks, and ardently attached to their free and roving life. A change, however, is coming over them. Under Russian influence they are gradually being taught settled habits. Their "zimofki," or winter habitations, along the main lines of communication, are assuming a more permanent character. The felt tent is supplemented, and in some cases replaced, by solid mud walls; and though their summer migrations (létofki) are almost as distant and unrestricted as ever, they return at certain seasons to cultivate the land, sow corn, and reap the harvest. At Verny, about twenty of the sons of leading and influential Kirghiz receive instruction in the Russian language, besides going through a course of Latin and Greek, as taught in all schools in Russia. Among the pupils are apt scholars, and the most proficient, I was told, may finish their education at the University. But the great obstacle to the employment of the natives of Turkestan in the army is their religion. Muhammadans make bad soldiers in a country where the population is mostly of the same faith, and desertions from the Turkestan Army were formerly so numerous that Government at last decided to send no more of its Mussulman soldiers to Turkestan. I came across some of these deserters, who are known as Chalar-Kazaks, and live generally on the outskirts of towns and settlements. They are married to Kirghiz, and lead a half-settled, half-nomad life. But if the natives cannot be utilized as soldiers they are of immense use in all military operations. Distances in Turkestan

are so great, centres of population so few and widely separated, that it is always a serious question how to supply troops on the march with food, water, and fuel, and without the co-operation of the pastoral inhabitants it would be impossible to supply these requisites in sufficient quantity.

But through the civil authorities arrangements are made with heads of cantons and elders, and by the time appointed everything is ready for the troops at their halting places. Moreover, when an Officer of high rank happens to be passing they attend in person and pitch a handsome felt tent for his accommodation. In order to throw as little strain as possible on the troops, they march in *échelons*, performing about 20 miles a day and resting every third day. This is the ordinary rate of marching, but of course they can do much more when required. Every regiment is accompanied by *djigits*, or native Kirghiz guides, who volunteer for the sake of adventure and novelty, or having been educated at one of the schools established for the purpose at Verny and Tashkend, act as interpreters to the Russian Officers. Here then is the nucleus of a guide corps to be raised in the future, perhaps, exclusively from natives. But by far the most important service of all is rendered by the Kirghiz horses. These little animals, averaging about $14\frac{1}{2}$ hands, are remarkable for their strength and endurance. The stories related of them might seem to border on the marvellous, had not my personal experience proved their extraordinary staying powers. During the disturbances which broke out in the Orenburg steppe in the autumn of 1869, a detachment under the command of M. Vogak, consisting of two sotnias of Orenburg Cossacks, 120 mounted riflemen, a three-pounder gun, and two rocket tubes, accomplished 1,000 miles in a month, with the loss of only three horses. But it should be borne in mind that half of this distance lay through deep sands (near the Aral Sea). The Officer in charge, whilst pursuing the robbers with the Cossacks, frequently rode 80 to 100 miles in a day, and on returning to the fortress after one of these forced marches he would sally forth again the following morning on the first report of the appearance of the object of his pursuit without changing horses. Extraordinary too is the speed with which one or a few horsemen can accomplish distances of 100 to 170 miles. In May, 1869, M. Vogak, accompanied by an interpreter and two Kirghiz, rode from Kara-butak to Irghiz, 107 miles, in less than 12 hours, on a hired horse, without injuring the animal in the least by the rapidity of the pace. Equally astonishing are the distances performed by Kirghiz themselves, always leading a spare horse. For instance, in April, 1869, a Kirghiz, sent by M. Vogak with despatches from Aralchi (north of the great Barsuk sands) to Irghiz, returned in 37 hours, having accomplished nearly 270 miles. After the battle of Chupan-ata, near Samarkand, in 1861, a djigit was sent to Tashkend, arriving there within 25 hours, having ridden 187 miles on one horse, a young 4 or 5 year old stallion. These extraordinary feats of Kirghiz horses remind me of a celebrated race at St. Petersburg, when the Earl of Durham was British Ambassador. He laid a wager that he would match three English thoroughbreds

against an equal number of Cossack horses. The course was from St. Petersburg to Tsarsko-Selo—a favourite summer residence of the Imperial family—and back, the distance—30 miles along a hard road. The six started, but only one, an English horse, finished. Vexed at their defeat, the Cossacks, who watched the race from beginning to end, actually tried dragging their horses in with ropes. From this it would appear that the remarkable staying powers which I have myself noticed in Turkestan do not show themselves if the animal is kept in stables in the European manner. The Kirghiz rarely shoe their horses. In spite of this, they are ridden over rocks and *débris* without injury to the hoofs and with greater comfort and security to their riders than if they were shod. It is singular to watch them descending the steep mountain slopes by a track probably made only by wild beasts. It is related of General Kolpakofsky, who had the reputation of being an indefatigable horseman, that wishing to show a companion a fine view over the surrounding country, he led him by a succession of steep zig-zags to the summit of a mountain, and at length halted on a rock with a sheer descent of several thousand feet, producing on his companion an attack of giddiness from which he was a long time in recovering. It requires a cool head and perfect confidence in one's horse to ride along ledges of rock, or wooden balconies carried along the face of a cliff, a perpendicular wall on one side, and a precipice on the other. In Badakhshan there are many such places barely wide enough for single horsemen to pass. A *rencontre* here is the most disagreeable thing that can happen.

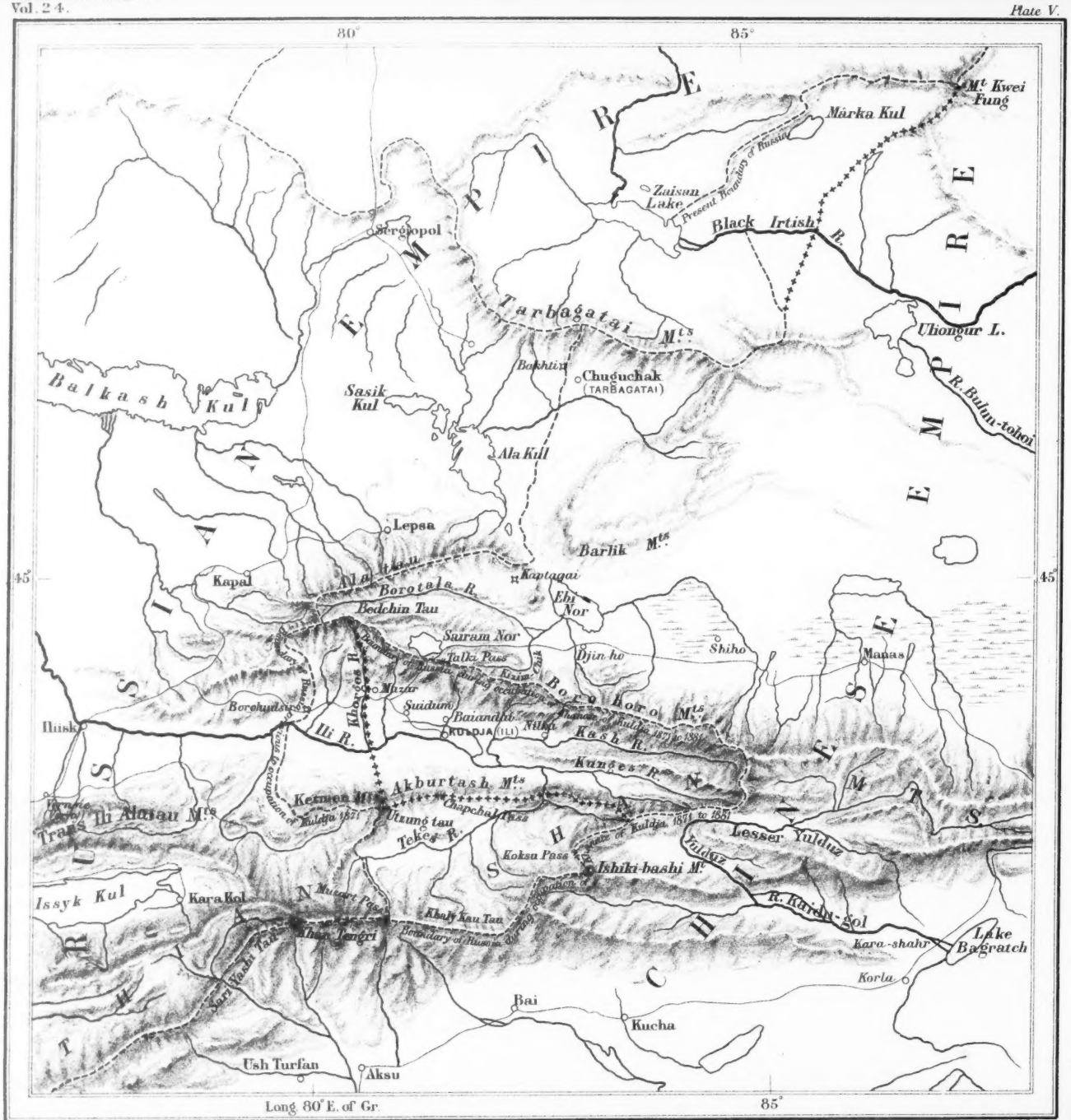
It would be impossible within the limits of this paper to do justice to Kirghiz horses. They are deservedly held in high repute in the Russian Army, for on them Bokhara, Khiva, and Kokand were subjugated; the cavalry and artillery are horsed with them, and all preliminary information upon which the plan of a campaign is based, and success so much depends, has always been collected by means of them. A Cossack Officer who served under Skobelef through the decisive campaign of 1876 in Ferganah told me that the celerity and boldness of this General's movements confounded the enemy. Taking with him a small detachment of mounted riflemen, he would attack and rout the Kokandians, and before they had time to recover he was again in their midst when they believed him to be miles away. He almost always rode at a hand gallop, and a spare horse was usually led for him; his men following at a trot could, with difficulty, keep up with him, and suffered terribly from heat and suffocating dust, filling the air in clouds and obscuring them from one another. Many fell out of the ranks, but the purpose was effected, and Kokand received a lesson it will not forget for many years to come. Horses thrive particularly on higher mountains, where pasturage is excellent, the climate fresh and bracing, and no flies and insects torment them. I once started to ride from Kizim Chik to Kuldja on a pony apparently not nearly up to my weight. This animal, however, carried me safely over a range of mountains, and at the end of the journey was as fresh as at the beginning. A good story is told of an eminent jurist in India, who on mounting a small horse felt him bend beneath

his fourteen stone weight; nevertheless, hardly had he taken up the reins when the animal bolted and ran fifteen miles before he could be stopped. Kirghiz horses are never vicious, although sometimes wild, and as jealous of liberty and averse to restraint as their Kirghiz masters. They will start and shy at bridges and dykes as English horses did some years ago at steam engines, requiring some attention on the part of the rider to keep his seat. A herd driven for the first time into a yard has been known to become unmanageable from sheer fright, and instances have been known of their killing themselves by rushing headlong against a gate-post. Russia was formerly herself a horse-producing country, and to this day some of her best cavalry mounts come from the country of the Don. But railroads, by diminishing distances, have affected the supply and demand for horses, and many large breeding studs are closed. In Central Asia, however, where every man, woman, and child rides, no matter how far or how short the distance, and where wealth is measured by the size of the stud, the supply of the noble animal is practically inexhaustible, perhaps not to the same extent as it was in the times of Jinghiz Khan and Tamerlane, because pasture grounds are more limited than they were, but sufficient, at all events, to provide a strong reserve for military purposes. The price of a good horse varies from 30 to 50 roubles, or about 5*l*., according to size, and they generally require no better food than such as grows by the roadside. Of course, in crossing deserts a supply of barley must be carried, and an allowance is made to the cavalry for this purpose, but if there be any herbage they will work as well without corn, and the Turgute, or Kalmuk horses, from Yuldus, will not touch it, as I know by experience. The authorities in Turkestan, alive to the importance of improving and preserving the equine race, have endeavoured to induce the nomads to pay attention to horse breeding, with the view of obtaining a larger class of the animal, but without success, and they now devote their energies to the establishment of private studs near Tashkend.

The Mongol tribes of Kalmuks and Turgutes may be dismissed with a very few remarks. Their history during the last century and a-half has been one continuous struggle with the Kirghiz, by whom they were almost invariably worsted. Their empire in Dzungaria was annihilated by the Chinese in 1736, and they received but little sympathy from the Russians. Tribes of them still inhabit the plains on the Lower Volga, round about Astrakhan. During recent disturbances on the Chinese frontier, a few hundred of them sought protection in Turkestan, and to this day they are employed at Verny and other towns chiefly as bricklayers. The bulk of them, despoiled of flocks and herds by Taranchis and Kirghiz, abandoned their favourite camping grounds on the Kungès and fled to Kara-shahr. Here the Turgutes, numbering it is said about 100,000, maintain a semblance of cohesion and their Lamaistic organization, paying, however, tribute to Russia. Remnants of Kalmuk tribes returned a few years ago and settled on the Upper Kash, where I found them last year. They looked scared and frightened at the sight of a stranger, as though haunted by the recollection of past misfortunes. Their features are

distinctly Mongol, with high cheek-bones and flat faces. Their dress consists of a long tunic gathered in at the waist with a belt, a round felt hat, loose breeches, and leather boots. They wear the long plait of false hair, falling from the back of the head and descending below the waist, a badge of subjection to China. In manners they are more genial than Kirghiz, and if they can lay aside their fears they are not slow in offering hospitality. Their food is chiefly milk, which they make into cheese and distil into wine. Meat they are too poor to eat except on rare occasions. They cultivate the soil and raise a little wheat. This they roast, pound into meal with a primitive pestle and mortar, and mix with tea and butter.

The regular military forces of Russia in Turkestan comprised on the 1st of January, 1879, 25 battalions (18 line, 4 rifle, and 3 local), besides half a battalion of sappers; 8 Cossack regiments (3 Orenburg, 2 mixed Orenburg and Ouralsk, 2 Siberian, and 1 Semirétchian); to these must be added a 2nd Semirétchian Regiment, making altogether 9 Cossack regiments; 88 field and mountain guns, making a total of about 50,000 rank and file. This force, numerically insignificant, being in the proportion of one to sixty-five of the population, guards a territory of about 400,000 square miles. Yet, thanks to excellent arms, good discipline, and all those qualities inherent in the Russian soldier, which are so well described in Lieutenant Greene's (of the United States Army) "Sketches of Army Life in Russia," it is amply sufficient to overawe the native population, and undertake expeditions beyond the frontiers. In time of peace, these forces are distributed in forts and citadels hundreds of miles apart, in most cases separated by desert uninhabited tracts, whilst strong reserves are posted at Tashkend and Verny. By "forts," I refer to fortifications erected by the Russians, and "citadels" must be understood to apply to native defences, consisting of high mud walls with ditch, parapet, &c. Neither would stand the test of scientific military criticism. They are capable, however, of being adapted to the requirements of modern artillery, and answer every purpose of Asiatic warfare. On the eastern frontier, Turkestan has an admirable natural rampart in lofty ranges of mountains, whilst on the west vast plains separate it from Persia and the Turkoman country. The most accessible, and therefore weakest part of the line is the centre. Here Fort Katti Kurgan and Samarkand Citadel control Bokhara, just as Forts Nukus and Petro-Alexandrofsk in the west keep watch over Khiva. But in neither case are strong garrisons necessary, for the Khans of Khiva and Bokhara are reduced to vassalage, indeed, General Kaufmann spoke of them as his best district governors. Ferganah, the late Khanat of Kokand, is enclosed on three sides by mountains, and has nothing to fear from external attack. The chief danger to provide against here is a possible rising of the population, as there was in 1876. To prevent this, strong garrisons are stationed at the most central of its populous towns. Further to the east, and a little north of Ferganah, are Forts Naryn and Kara-Kol, observing Kashgaria, now in the possession of China, and ready to dispute, if necessary, any pretensions of the latter Power to extend her empire to the west. Kara-Kol, too,


80°
85°
45°
Mt Kwei Fung
Márka Kul
Zaisan Lake
Present Boundary of Russia
Black Irtish R.
Ulungur L.
R. Bulun-tokoi
Sergiopol
Tarbagatai Mts
Bakhtin
Chuguchak (TARBAGATAI)
Balkash Kul
Sasik Kul
Ala Kul
Lepsa
Barlik Mts
Kapal
Kaptagai
Ebi Nor
Alatau
Borotala R.
Bodchin Tau
Sairam Nor
Talki Pass
Djin ho
Shiho
Manas
Muzar
Suidun
Baiandai
KULDJA (ILI)
Nilki
Ili R.
Khorgos R.
Borohudsir
Ruisk
Kash R.
Kunges R.
Bogdo Ola Mts
Akburtash Mts
Kemen Mts
Trans Ili Alatau Mts
Chapchal Pass
Usumé tau
Tekes R.
Koksu Pass
Ishiki-bashi Mts
Lesser Yulduz
Yulduz
Issyk Kul
Kara Kol
Muzart Pass
Khan Tengri
Khaly Kau Tau
R. Kaidu-Gol
Kara-shahr
Lake Bagratch
Korla
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Long. 80° E. of Gr.
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0 10 20 40 60 80 100 MILES
Stanford's Geog.l Estab.t

protects the Russian settlements at the east end of Lake Issyk-Kul, whilst Naryn serves as a check upon the nomads who belong to the warlike Diko-Kámenni, or Wild Rock Kirghiz. Both these forts are united with Verny and Tashkend by post roads. East of Kara-Kol, an outpost of half a sotnia, or 50 Cossacks, guards the entrance to the almost impracticable Mussart Pass, and the valley of the Upper Tekès. North of this are Forts Borohudsir, on the right bank of the Ili, and Bakhti, 12 miles west of Chuguchak, with an intervening outpost of one sotnia at Kaptagai on the old caravan road, passing through an opening in the mountains of Alatau and Barlyk, celebrated from time immemorial for the violent wind always blowing there. This section of the frontier between Mussart on the south, and Kaptagai on the north, is in dispute between Russia and China. A glance at the map will show that the watershed of the higher mountains forms here two ravelins, the apex of the more northern one projecting to the west, that of the more southern one to the east. The former, comprising the valley of the Borotala, Lakes Sairam-nor, 7,000 feet above sea level, and Ebbi-nor, barely 700, is generally barren and unproductive, except the steep slopes of the marginal ranges, where pyramidal pines, shooting up with tall slender crests, lend a pleasing contrast to the rugged rocks and sterile plains at their foot. The angle enclosed in this ravelin is crossed nearly throughout its entire length, from east to west, by the Chinese Imperial highway, which descends by the Talki defile on the west, to the rich and fertile Kuldja region, comprising the valleys of the Upper Ili and its tributaries the Kash, the Kungès, and the Tekès.

The Chinese, who held it till 1865, when the Muhammadan insurrection broke out, made of it a granary for the supply of all their garrisons at the foot of the Thian Shan. It was also useful to them as a penal settlement. In addition to the extensive coal-fields, worked to this day by Russians and others, there were gold, silver, and copper mines, now neglected. Its extreme length, from the sources of the Kash (lately discovered by Dr. Regel) and the Kungès, on the east, to Borohudsir, on the west, is about 250 miles; its greatest breadth from ridge to ridge of mountains, or from the lofty valley of the Yugentass, where the Borohudsir rises, on the north, to the ice-bound Mussart Pass on the south, about 180 miles. Through its centre flows the wide, deep stream of the Ili, watering a valley about 50 miles broad and girt on either side by lofty ranges. Between Borohudsir, a Russian fortress (where there are barracks and a commandant who enjoys the classical name of Menshikoff), and Suidun, a large settlement of Dungans, the country is covered with ruins of Chinese towns, built of the usual material here, unbaked bricks, and therefore rapidly dissolving into clay under the combined effects of time and weather. Between the towns are parks of elms (*kara-agatch*, or black elms) and watercourses, all neglected and becoming a wilderness. These scenes instinctively suggest the question, why has nothing been done to arrest the progress of decay and restore the country to comparative prosperity? The answer is, the population has disappeared; they fell in the terrible drama enacted here between the years

1864 and 1867. Some fought for their life and all that makes life worth living for; others, stirred by fanaticism, drew the sword for Mahomet, foes to Buddhism and indifference; others, again, struck a blow for liberty, relief from oppression, and vengeance for wrong; but, whatever their motives, here lie their bones, half-hidden in the rank grass growing round the crumbling and deserted ruins.

Accompanied by a Taranchi, who spoke Russian, and had personally taken part in these events, I visited the ruins of Baiandai, near the foot of the mountains 6 miles north-west of Kuldja. The walls of the citadel, of great height and strength, are almost intact. They form a parallelogram about three-quarters of a mile from north to south, and a third of a mile from east to west. The space within was closely packed with houses, of which almost nothing remains, and the ruins are nearly level with the ground. Near the north end, where the official dwellings were situated, some walls are still standing. In the centre is a tower or stronghold, to which the garrison retired at the last extremity, and here they made their last desperate stand, doubtless selling their lives dearly. The siege lasted three months, the attack was delivered on the south front, and the besiegers were encamped about one hundred paces from the gate, defended by the usual massive semicircular bastion. The combined Dungan and Taranchi forces were armed with any kind of weapon they could lay their hands on, from stout elm cudgels and agricultural implements to guns captured from the Chinese. Their mode of conducting the siege was primitive. At the close of every day they retired to their villages, returning again in the morning to prosecute operations, but by the advice of a Sart, who appeared later on the scene, they began a more systematic style of attack. Under his direction, they threw up a mound, in order to command the fire from the walls, and when the besieged tried to explode a mine under it, they began countermining. Their gunpowder was of inferior quality, manufactured by themselves. They attacked sometimes at night, and in hand-to-hand fight with the Chinese always got the best of it. At the end of three months they set fire to the town, and the flames spreading soon enveloped the whole place in a general conflagration. It was impossible to save anything. The inhabitants, numbering 75,000, all perished, and I saw the wells at the north end of the town into which the women were thrown after being drugged with opium. We rode along the summit of the wall in order to have a better view of the position, then descending by an inclined passage passed through the town and out by its western gate on our way to visit the coal mines, and I was glad to leave this scene of desolation. The Chinese, on the first symptoms of revolt, endeavoured to crush it by seizing leading Dungans, enticing them to New Kuldja on the Ili under various pretences, and beheading them at Chinchahodzi, exposing their heads in cages along the high road. Afterwards they directed their efforts towards detaching the Taranchis from the Dungan cause, promising them full and complete amnesty and large rewards. But all in vain. They were at length reduced to great straits. No reinforcements had reached them from China, nor, indeed, was this possible, for the whole country to the east was in a disturbed

state, their appeal for succour to Russia had elicited no response. The war had lasted three years—their supplies were consumed. At New Kuldja every dog in the place had been devoured—their Mongol soldiery, the Solones, and Sibos on the opposite side of the Ili failed them in their hour of need, and nothing but death or conversion to Islam remained. Such is very briefly an outline of events in the Ili Valley. I need not take up valuable time by relating what followed—how the Taranchis and Dungans fought for supremacy; how the former gained the victory and established their Sultan, Abil-Ogla, at Kuldja; how his ephemeral sovereignty was brought to an end in 1871 by the Russians who advanced under General Kolpakofsky, and occupied the country after firing one cannon shot, and with trifling loss to themselves.

When I visited this region last June, great preparations were being made to hold it against a Chinese force said to be advancing to take it. About 8,000 men of all ranks had been collected from all parts of Turkestan, and marched to Kuldja. Their disposition was briefly as follows:—A strong detachment of infantry, with artillery and Cossacks, guarded the northern entrance to the Talki defile. They were encamped at the foot of the heights overlooking Lake Sairam, a splendid sheet of water transparent as crystal, but entirely devoid of animal life. The artillery and Cossacks were in tents, about a mile to the right of the pass; the infantry, a mile beyond, had built themselves huts of boards and fir branches, as a protection against cold, for it felt chilly at this elevation (7,500 feet), even in July. They were, also, engaged upon the construction of a boat to navigate the lake, but had not completed it at the time of my visit. I drove and rode up the Talki gorge with a Russian Officer. Hiring a Dungan arba, or high two-wheeled cart and two riding horses, we started at nine in the evening from Suiden and reached the entrance of the defile early in morning. The ascent occupied the whole day. No words of mine could depict the beauty of the scenery or variety of the vegetation. The road, which is good throughout, crosses and recrosses an impetuous mountain torrent by forty-eight bridges (I did not count them). The last mile of ascent is steep. At the very summit a spring of pure water issues from the ground. From this point a magnificent view opens over the Lake of Heaven, as the Chinese called it, doubtless from its deep blue colour, inclosed on all sides by mountains capped with snow. Its length, from east to west, is 18 miles; its breadth, from north to south, about 14 miles. At the eastern extremity are two small islands, called Kotchegan-tash, and some ruins. Near these the Chinese Imperial highway runs at the foot of a ridge of hills called Tukhum-ti. I passed the night under canvas, a tent having been kindly placed at my disposal by the Officers, and the following morning rode to Kizim-chik, 8 miles along the foot of the Borohoro range, where, as I have already mentioned, a sotnia of Cossacks was posted. Beyond this my wanderings did not extend towards China, for I recrossed the mountains from Kizim-chik, descending by the Pelliuchi Pass to Colonel Kuropatkine's camp at Mazar, at the southern foot of the range. But I learned that a line of

cavalry outposts extended eastward from Kizim-chik as far as Toghur-su, south of the Chinese outpost at Djin-ho. Strong detachments held Toghur-su and Atchal, another pass to the west of it, about half way between Toghur-su and Talki. The infantry reserve, under the command of Colonel Kuropatkine, of Kashgar fame, was at Mazar, a somewhat confined position between two spurs of hills, badly supplied with water for so large a force, and infested with tarantulas. The cavalry division, consisting of two regiments, or about 1,400 men, under Colonel Matvéief, was encamped at Chijan-togai, on the Upper Kash, about a hundred miles to the east of Kuldja. Their position, although possessing advantages of abundant water and forage and a healthy climate, was unfavourable for reconnaissances, the Kash being unfordable. This river rushes along an impetuous torrent, in a rocky bed, from one to two hundred feet wide, forming islands and rapids in its course, and occasionally flowing at the foot of precipitous banks of clay and sand, rendering futile all attempts to bridge it. Colonel Matvéief narrowly escaped drowning when trying to swim across it, with a disabled arm. The artillery was about 20 miles lower down the Kash, near the Taranchi village of Nilki. The headquarters of the army with Generals Kaufmann, Kolpakofsky, and Count Levashof were at Kuldja. I may add that the men looked in capital condition, and were in good spirits, notwithstanding the long marches many of them had made.

With regard to the Chinese I can say but little, because I did not see them, neither did I meet anyone who had visited their army, and, rather than give any doubtful information, I prefer to quote from my friend Dr. Piassetsky, who accompanied Colonel Sosnofsky's expedition across China in 1874–75. I would preface these remarks by saying that the Chinese do not understand the word "patriotism," and have no idea of conducting a war as we should. For instance, while I was at Semipalatinsk, its Governor, General Protsenko, who has charge of that section of the frontier between Forts Zaizan and Bakhti, told me that when matters were most critical and hostilities imminent on the Kuldja frontier, the Chinese Governor at Chuguchak continued friendly relations with him, and said that whatever might happen between the Tsian-tsiun and the Governor-General of Turkestan, he saw no reason why their friendly intercourse should be discontinued. Relating an interview at Lan-chau-fu with General Tso, Governor of the western provinces of China, Dr. Piassetsky says that this mandarin, after some conversation, asked which would gain the day if war were to break out between Russia and China, supposing their forces to be equally matched as regards numbers. This embarrassing question all the members of the Russian Mission answered evasively, but their host returned again and again to the question, till at length they were obliged to say that Russia would be the conqueror—an answer which threw him into a fit of deep dejection. Some days afterwards they were present at manœuvres. The troops, comprising cavalry and infantry, were all dressed in brilliant-coloured garments, and went through their movements, formations, attacks, retreats, volley firing, &c. This continued

three hours, with intervals of repose, during which the soldiers sat down on the ground. After the regulars had gone through their exercises, a troop of from fifteen to twenty boys, ten or twelve years old—the so-called *Yui-Bing*, or pupils, made their appearance. They performed gymnastic exercises, shot with bow and arrow and toy guns, but all their movements were accompanied with strange antics and contortions of body, more like those of clowns, but certainly unsuited to soldiers. Nevertheless, these puppets, with their hideous grimaces, attracted more notice from the General than his soldiers, and he seemed to attach importance to them. They were even said to receive salaries. After this marionette performance, riflemen appeared with peculiar guns consisting of barrels without stocks, finished in a most extraordinary fashion. The wonder was how they were ever to go off. The cock was above, not at the side; there were no triggers, but were fired by means of a spring let into the side, which had to be pressed. Taking this barrel in both hands like an acrobat his balancing pole, the soldier bends his arms, pressing the elbows inwards, then raising the weapon to the level of his face, he looks towards the left along the barrel, takes aim, presses the spring, and fires. Anyone the least experienced will readily understand the absurdity of this style of thing, and the inconvenience and difficulty of firing, to say nothing of the impossibility of making any number of consecutive shots, and the state of the unfortunate soldier's hands after having done so. "Heavens!" exclaimed Dr. Piassetsky, "how unfortunate are they whose "commanders are these ill-educated, thoughtless mandarins." Little attention, too, is paid in the Chinese Army to firing practice; most of the men confess their inability to take aim, though they can fire off their guns holding them in the position of bayonets, so that they might perhaps hit masses of men outside the range.

Against such troops as these the Russian battalions were massed in Kuldja; no wonder that the war was unpopular, and that many chafed at the inaction and longed for a more worthy foe. The Chinese Commander-in-Chief is said to have written to General Kaufmann to say that he could not be ready before autumn, and that he hoped that the latter would not begin till he was. In this way matters went on, and when I left Kuldja on the 1st August there seemed no probability of their being brought to an issue.

It having been suggested that it would add to the interest of my paper if I were to give the latest accounts of the strength of the Russian and Chinese forces on the frontier, I am enabled, through the courtesy of the Intelligence Department of the War Office, to supplement personal observations by the following particulars. The Chinese forces at Shiho and neighbourhood numbered, in last October, 13,000, of whom 4,500 were cavalry. They were quartered in small huts of native construction, surrounded by mud ramparts with embrasures, and called *impans*, answering to the kurghans of Asia. The cavalry were Manchus, the infantry Chinese. The regiment is the *lanza*, comprising 500 infantry or 250 cavalry, but it is rarely up to full strength. There were no magazines or stores of provisions, but supplies of flour for the troops were brought from

Manas and a large depôt at Yang-tsi-hai on the Manas road between this place and Shiho. Last year's harvest was estimated to yield barely ten months' supplies; barley was scarce, and reeds and hay took the place of clover. The men had no warm clothing or felts to lie upon. A transport service had been organized with arbas, drawn by two mules and a horse. The soldiers were very irregularly paid their wages owing to the notorious peculation of the Chinese Officers. The daily rations were $2\frac{1}{4}$ lbs. of flour or millet and $\frac{3}{4}$ lb. of meat, but this latter was not always obtainable, owing to a scarcity of sheep. Instead of it opium was served out, an arrangement with which the men were well satisfied, for they all smoke opium, though General Tso had strictly forbidden its use. News of movements of Chinese troops to the west from Hami and Barkul had been confirmed. No changes or additional fortifications were reported in the valleys of the Emil and Black Irtysh. In Mongolia, however, reinforcements had been received at Hobdo and Uliassutai. General Tso was at Hami by last accounts enrolling a corps of 10,000 Dungans, who had co-operated in the subjugation of Kashgaria. The export of fruit and salt from Russian Semirétchia had been stopped, whilst the Chinese had placed a prohibitive duty on the export of Ehbi-nor salt. Kamensky, the well-known Russian merchant, whose dealings with the Chinese Government for the supply of their Army with provisions had been investigated by a special Committee, had refused to abide by their decision, and the Governor-General had, therefore, instructed the local authorities to advance a sum of money in part payment of the award.

Altogether matters were in a very unsettled state, both on the Kuldja frontier and in Eastern Turkestan, where the Chinese had, by all accounts, made themselves extremely unpopular with the Muhammadan population. It was reported that a mutiny had broken out in the Chinese Army advancing to occupy the Western Provinces, ending in serious hostilities.

Major Sarandinaki, Commandant of Fort Bakhti, while on a tour of inspection, had a skirmish with a predatory band of Kirghiz near Lake Djelanash-Kul, and had succeeded, although his escort numbered only nine Cossacks and an uriadnik, in routing the robbers, rescuing 204 of the horses they had carried off.

When I left Kuldja there was some talk of going into winter quarters.

The CHAIRMAN: If there is no one who has any observations to offer on the paper, I may perhaps say a few words on this important subject. Major Clarke, R.A., in a very interesting paper read last autumn at a meeting of the Royal Geographical Society, observed that there is perhaps no district in the great central plateau of Asia that is playing so prominent a part in history as this very district of Kuldja. Situated at the north-western angle of the great central plateau where alone it is accessible—and in fact the main artery of communication is the great Chinese carriage road from Hankow to Kuldja, and between the west and east of Asia—the great highway of the Kuldja oasis has been pointed out as a resting-place for those vast hordes of Mongols, Turkomans, and Kirghiz, whose migrations, conquests, and defeats have in time past altered the whole face of the civilized world, and form some of the most important chapters in the world's history. I need not

remind you that the high plateaus of Central Asia have been the nursery of great nations, and the cradle of founders of Empires. These wild regions are little altered in physical features since the Mongols swept across Asia from east to west, carrying many of these intervening tribes with them under Genghiz Khan, and subsequently when they penetrated to the heart of Hungary and the plains of Poland, stabled their horses in the Kremlin, and knocked at the gates of Vienna, and the Turki race have occupied in the last four centuries the basin of the Lower Danube, and are now in the Balkan Peninsula, and constitute by their presence one of the most knotty problems of modern diplomacy, which we know by the too familiar term of the "Eastern Question." Kuldja is now again coming into the forefront of modern politics, inasmuch as two out of the three great Empires in Asia, the Russian, the Chinese, and the British, are impinging on this very plateau of Kuldja; and it is a bone of contention and of very serious conflict, as to whether this fertile oasis, occupying an area of some 25,000 square miles, shall remain in the possession of China or of Russia. It may seem that this is a question which does not very nearly concern the other Western Powers, but a moment's reflection will show that it has a very important bearing, more especially upon British interests. It is very true that Kuldja and the district on each side of the Thian Shan, or Celestial Mountains as they are called by the Chinese, is a long way off from the borders of India, and in that sense perhaps it does not very directly affect us. But if Russia and China cannot come to some understanding on that subject, very naturally the first course that Russia would take, and she has been preparing a large fleet in the Pacific for the purpose, will be to threaten Peking, and to blockade the Chinese coast. Any step in that direction must very seriously affect the interests of the Western Powers generally, and ourselves more especially, because of the 40,000,000*l.* of foreign trade that there is with China, which is all seaborne, about nine-tenths belongs to Great Britain. I need not say we should be very much distressed for want of our tea, the supply of which would be very seriously interfered with, and as last year we imported some 159,000,000 lbs., a famine of tea would interfere very materially with the comfort, if not the health, of a large portion of the population of Great Britain. Eight millions of revenue are also dependent upon the importation of opium into China from India, and that also would be very seriously interfered with if not lost altogether. It must be quite obvious, therefore, what is going on in this north-western corner of the great central plateau of Asia, which might appear to be far removed from any interest of the other Western Powers, is a question of immediate and direct importance to Great Britain more especially, though it affects more or less all the other Western Powers who have any commerce with China. Under these circumstances perhaps we should have been glad if Mr. Morgan in his interesting paper had given us some little more information about the physical geography of this region, because the whole question between China and Russia is very much influenced by it. Indeed, I do not know any part of the world where the physical and the political geography of the region is more directly connected, and more certainly influencing the policy of two great Empires. It is the great caravan route from time immemorial by which China has maintained communication with the West, and in which all the great trade routes have a centre of connection. Kuldja is also connected with the great Siberian post-road, and thence with all parts of Eastern Turkestan by a carriage road through Borohudsir and the Altyn-imel Pass. The trade from China has two roads of approach, the one on the north of the Al-tài range, and the other on the south, and the latter leads directly from the south-west angle of the Great Wall by the Kiayu Gate, across the narrowest part of the Desert of Gobi, here only some 150 miles across; and from Hami on the western border, there is a direct road of some 300 miles to Kuldja, and thence to Yarkand. The roads that come from south and west centre there, and it has always been an emporium of commerce. The importance to China of the part which has been claimed by Russia, especially the southern portion of the Ili, is this, that any Power possessing the passes of the Thian Shan range completely commands all the traffic in that region; and they not only control the trade by the command of the main lines of communication, but they get the command over the Kirghiz inhabitants upon whose herds the transport through these regions is entirely dependent. Any Power possessing the Thian Shan and its passes and control over the Kirghiz, would effectually prevent any communi-

cation, cutting off China in the first place entirely from Eastern Turkestan, and also giving to a Power like Russia a very commanding position, both for offence and defence, threatening the western gate and the entrance to all the rich western province of China. That is quite sufficient, I think, to show you that both the physical geography, and what is going on now in that region in the way of negotiation, is a matter of considerable interest and importance to the Western world, and to ourselves more especially. I perceive that Mr. Morgan takes the Russian view of the matter: that in the great advance and conquest of the three khanates of Kokand, Khiva, and Bokhara, and also in the still later advance against the Tekke Turkomans towards Merv, they are in fact playing the part of civilizing and humanizing agents; that such advances are an unmixed benefit to these people, and that it is not a barren conquest even to the Russians. I think there may be some considerable question about these premises. It no doubt has entailed considerable sacrifice on Russia, both in men and money, and whether they will foster trade with their protectionist ideas which will give them a sufficient return, is more or less doubtful. But certainly, wherever they extend their influence, it is not a benefit to general commerce or to the native States, because they always carry with conquest a prohibitive commercial policy which effectually deprives all those regions of any trade, except that which is desired by Russia herself. So again, as to whether they are a humanizing and civilizing agency, no doubt to a certain extent they are, because they have a higher civilization and better organization, and they have to deal with wild men. I think the Arab proverb says, "Wild lands breed wild men," and these warlike and predatory tribes are between the deserts of the Caspian basin and the Desert of Gobi; and of the Desert of Gobi it has been said, that it has neither man nor bird, nor water nor smoke, and where there is no smoke there can be nothing. As to reducing those tribes, for the most part nomad, to anything like settled habits and the cultivation of the soil, all I can say is, if Russia has undertaken that, she has a task which will last her for the next half century at least, and at best it will be a very costly enterprise, which will require all her power to carry out in a satisfactory manner. There was one observation of Mr. Morgan's I must take a little exception to. He referred to the negotiations of the Russian diplomatists at Peking in 1859, and I think the observation was to the effect that, while by force the French and ourselves were extorting certain concessions, the Russians, by their fairness and tact, were enabled to get all those advantages which we had to fight for. But I think Mr. Morgan must see that nothing was easier, when the Chinese were entirely occupied with a formidable foe at the gates of Peking, and the Emperor in flight to Jehol, and Russia came with demands upon them, with a fair seeming of friendship, feeling at the same time that they were going to yield these advantages to the armies in front of them, they naturally did not make much difficulty in conceding the same or other advantages to those who were negotiating with all the advantages of a victorious force. I am not, therefore, inclined to give the Russian diplomatists all the credit Mr. Morgan is disposed to do for their successes. I think any other diplomatist under these conditions would have found it easy work to get the same advantage. We are much indebted to Mr. Morgan, however, for a great deal of recent information as to the present state of affairs, coming, as it does, from an observer on the spot, which will always have an interest not felt when persons are merely relating what they have heard from others. I do not know whether Mr. Morgan may wish to make a few observations; if he does, I will give him the opportunity.

Mr. DELMAR MORGAN: With regard to the physical geography of that region, it is very easily understood. It is a succession of ranges inclosing valleys. The northernmost of these is that of the Borotala, which rises at a very high elevation in the mountains forming the angle of the northernmost ravelin, and this part of the country is barren and rocky, except, as I have said, the fringes of the hills. But on entering the district of Kuldja to the south you come to what was once a very fertile and highly cultivated country. There are several passes through that northern range, marked on maps as the Boronoro, but also known to the inhabitants under various local names after the different peaks. I rode up the Ili Valley, and its chief tributary, the Kash, with two Kalmuk guides, who knew every mountain, and repeated its name to me, till I desisted writing them down. There are several ways

of crossing it. The chief pass is the Talki, through which the Imperial highway runs. There are several others to the east; through one of them, the Atchal, Russian soldiers are making what will be a good road. The valley of the Ili above Kuldja is extremely fertile; in every direction villages and plantations are seen; the soil is well cultivated; there is a great deal of wheat and barley grown, as well as opium.[1] That is ascending the river. Going downwards, you see the whole country in a state of absolute ruin and desolation. It must have been once very fertile, and I saw traces of the fertility which once existed. There is a great work made by the Chinese—a large canal which used to supply Baiandai and the towns around Kuldja and to the west, taking a large quantity of water from the confluence of the Kash with the Ili, for 40 to 50 miles; that canal is almost as good as it was when it was made by the Chinese. The southernmost of the three valleys is the Tekès, a very interesting and very fertile valley. There was a large Kalmuk monastery[2] there, now in ruins. I had intended going on there, but unfortunately my time did not allow me to visit the Mussart Pass. The upper valley of the Tekès belonged to Russia before this question arose; and I presume Russia would still retain that, although she retroceded the other part of the province of Kuldja to China. With regard to the position of China in these countries, it seems to me, from what I could see, a very weak one. When she retook Kashgaria two or three years ago, her force was a very small one, and she was enabled to take it owing to the dissension which existed in the country itself. One of the first acts of the Chinese was to capture all the horses of the natives, and to destroy a great many of them, and in that way to control the people.[3] But they are weaker there, and they are also weak to the north of the Thian Shan. The Chinese Officers whom I met at Semipalatinsk said at Shi-ho, the headquarters of the Chinese General, there are very few houses till you come to Ouroumchi, which is partially rebuilt. I think, in some ways, the Russians have done good in putting an end to a great deal of anarchy, and even putting an end to those independent Khans, who were frightful despots, and did nothing for the progress of civilization. At the same time, I can see Russia has a great work before her in Turkestan. She must devote herself to it, and I think she might do more perhaps for commerce and industry than she is doing at present. The country is now perfectly quiet and peaceful, and all that is wanted is railway communication in order to develop the trade and natural resources of the country, and irrigation works to turn some of its deserts into fertile districts, as, I have no doubt, it is quite possible to do. Only the other day I heard that vegetation had appeared around the fresh water canal which supplies the Suez Canal, although it lies through a dry and sterile desert; and I have no doubt the same thing could be done in Turkestan. At the foot of the mountains there are belts of fertile country which are capable of growing anything, and the climate is very good. Of course, when you get into the mountains you have most beautiful scenery and a great variety of vegetation.

The CHAIRMAN: I am sure you will allow me to express your thanks to Mr. Delmar Morgan for his very interesting paper.

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[1] About 10,000 acres are under cultivation for the poppy.

[2] The monastery of Sumbah.

[3] They were still pursuing these tactics last autumn north of the Thian Shan.

Wednesday, March 9, 1881.

MAJOR-GENERAL HIS ROYAL HIGHNESS THE DUKE OF CONNAUGHT, K.G., &c., Vice-Patron, in the Chair.

THE MARCH FROM KABUL TO KANDAHAR IN AUGUST, AND THE BATTLE OF THE 1ST SEPTEMBER, 1880.

By Lieut.-Colonel E. F. CHAPMAN, C.B., R.A., &c.

IN July, 1880, there were in the field in Afghanistan two separate *corps d'armée* with distinct bases of operation, the one dependent on the Punjab and the Presidency of Bengal, the other on Scinde and the Presidency of Bombay; these were officially designated "The "Northern Afghanistan Field Force," and "The Southern Afghani-"stan Field Force;" the division in Kuram, or the "Kuram Force," being, for the purposes of the military operations, grouped with troops in occupation of the city of Kabul and the valleys adjoining.

The separation of the province of Kandahar from Kabul had been promulgated, and, at the period under consideration, the political objects for which the two forces were maintained were entirely distinct, their Commanders reporting independently for the information of the Commander-in-Chief in India. At Kabul, steps had already been taken to prepare for the evacuation of the country so soon as negotiations, then being carried on with Abdul Rahman Khan, might be successfully completed; and, early in July, Sir Donald Stewart looked confidently to the 15th August as the date on which the last of the brigades under his command would leave Kabul. The plan of withdrawal had been fully considered, and it only needed the issue of final orders to set in motion upon two lines towards India the 18,000 men forming the army of occupation, the intention then being for Lieutenant-General Sir Frederick Roberts to command the troops retiring by Kuram, while Lieutenant-General Sir Donald Stewart retained the command of those to move by the Khyber. The sick were already in motion towards Peshawur; warlike stores and baggage in excess of actual requirements had been despatched to the base; and, in the strictest sense, the Northern Afghanistan Field Force was held ready for movement.

It is not necessary to compare the arrangements that maintained at Kabul with those in force at Kandahar, nor to show how they had been matured by experience gained during two years of continuous field service; but before passing to a detailed account of the march which forms the subject of this paper, it is important to draw attention to the quality of the troops constituting the *corps d'armée* from which Sir Frederick Roberts's force was drawn, to lay stress on their superior physique, and to recall the fact that Officers and men

had gone through together the training of a lengthened period of active service. It is not too much to say that, in fighting power and intelligence, the troops in question could not be surpassed, while their equipment was in the very highest order.

The news of the defeat of Brigadier-General Burrows' Brigade at Maiwand, and of the withdrawal of our troops at Kandahar within the city, reached Kabul by telegraph on the 28th July, and it was at once felt by the Generals in command that, however great the efforts which might be made, the relief of Kandahar could only be effected from Scinde, at that season of the year, with great delay and difficulty; the possibility of a movement of troops from Kabul was indeed fully considered at the outset, and when Sir Donald Stewart was called on by the Government of India for his opinion, he counselled the despatch of a force from Kabul under the command of Lieutenant-General Sir Frederick Roberts to accomplish the object in view. The approval by the Government of India of the operation proposed, and the orders of his Excellency the Commander-in-Chief, were received by telegram on 3rd August.

These practically left the constitution of the force, its equipment, and other details to be decided on the spot. Sir Donald Stewart was, however, called on to state what was the earliest date on which the march could commence, and when the relieving force might be looked for at Kandahar. It was decided to leave Kabul on the 8th August, and it was estimated that, on the 2nd September, Kandahar would be reached. Meanwhile, during the last week of July, the arrangements initiated with Sirdar Abdul Rahman Khan had been satisfactorily advanced towards conclusion, and it was determined to tell him the exact truth regarding the situation at Kandahar, and at the same time to seek openly his assistance in obtaining supplies during a march to be directed against his acknowledged rival. As, however, reliance could not be placed on Afghan assurances in such a crisis, the strictest independence in the execution of the movements then contemplated was ensured by careful preparation against any contingency. The 11th August was fixed for the withdrawal towards the Khyber of the troops destined to return at once to India, a Governor appointed by the Sirdars was placed in charge of the city, and arrangements were made for handing over the Bala Hissar, and the buildings in the Sherpur cantonment, to Abdul Rahman's representatives, on the morning our troops should vacate.

A march conducted without a base of operations or communications of any kind, through a hostile country, and towards a point presumably in the possession of an enemy who had been recently successful, could only be warranted by such necessity as had arisen; in this instance, however, the wisdom which prompted the measure, and the courage which executed it, sprang of experience, and of the confidence which claims success as a certainty. The result justified the conception, and the march from Kabul to Kandahar has been recognized as a great achievement. It will be remembered that at the time it was undertaken, and until a crushing defeat had been inflicted upon Ayub

Khan at Kandahar itself, the movement was condemned in no measured terms, by military critics, its originators being judged to have acted in complete disregard of the principles of military science; with troops, however, trained and equipped as were those selected for the undertaking, a commander may, humanly speaking, anticipate success in any enterprise.

The measures of thoughtful preparation carried out during the few days that remained to Sir Frederick Roberts, before movement commenced, may be classed under two heads:—

1. The selection of the troops, followers, and baggage animals.
2. The survey and completion of equipment.

No record of the work thus undertaken would be complete which did not set forward very prominently the self-abnegation and high military capacity evinced by Lieutenant-General Sir Donald Stewart, who was in supreme command at Kabul, and who, without reference to the difficult task of withdrawal by the Khyber, which was to be his share of the programme, placed unreservedly at Sir F. Roberts' disposal the entire resources of the North Afghanistan Field Force in transport and equipment; nor would it be possible to pass by without respectful recognition the singleness of purpose and true genius with which the two commanders devoted themselves to perfect the machinery which it was intended to employ in the execution of a difficult enterprise. The spirit they evinced became the leading principle that guided all ranks in the task of preparation.

It is hard to appreciate fully the difficulties which beset a commander in the selection of troops for special service; it is at the same time important, in reviewing the duty which devolved on Sir Frederick Roberts, when called on to name particular regiments for the service in hand, to recognize that the exceptional hardships and difficulties involved in the undertaking were exactly understood by the rank and file of the Army. The sentiment with which the announcement that a force would march to Kandahar was received was that of a strong sense of duty, rather than the enthusiasm of troops who had their reputation to make. Very many of the corps serving at Kabul, more especially native corps, had been for two years absent from their homes; they had seen a good deal of fighting, and had suffered heavy losses in action and through sickness. The native troops in Northern Afghanistan had welcomed the possibility of an early withdrawal to India, and, very justly, felt themselves entitled to rest. It was not with eager desire that the honour of marching to Kandahar was sought for, and some commanding Officers of experience judged rightly the temper of their men, when they represented for the General's consideration the claim of the regiments they commanded to be relieved as soon as possible from field service. I lay stress on this fact, and claim for those Officers who subordinated their own wishes in the interest of the soldiers they commanded, as also for the General who acted on their representations, an insight into the character of our native troops, the result of long experience. It is not easy to estimate the confidence created by such knowledge as was thus brought to bear on the question of

selection, nor rightly to describe the sense of duty and of absolute trust in their commanders which marked the behaviour of the troops at this time. The enthusiasm which carried Sir Frederick Roberts' Force with exceptional rapidity to Kandahar was an after-growth, evolved by the enterprise itself, and came as a response to the unfailing spirit which animated the leader himself.

The detail of the Force placed under the command of Lieutenant-General Sir F. Roberts, and destined for special service, was given in Northern Afghanistan Field Force Orders of the 3rd August. The returns of batteries and regiments placed the effective strength as follows:—

	British Officers.	British N.C. officers and men.	Native Officers, non-commissioned officers, and men.		
Staff	79				
6 | 8 Royal Artillery (Mountain Battery).	6	95	Drivers and Muleteers.	139	Royal Artillery.
11 | 9 Royal Artillery (Mountain Battery).	6	95	Drivers and Muleteers.	139	
No. 2 Mountain Battery (Punjab Frontier Force).	5	..	..	140	
9th (Queen's Royal) Lancers.	19	318			Cavalry Brigade.
3rd Bengal Cavalry	7	..	..	394	
3rd Punjab Cavalry (Punjab Frontier Force).	9	..	..	408	
Central India Horse	11	..	..	495	
92nd Highlanders	19	651			1st Infantry Brigade.
23rd Punjab Inf. (Pioneers).	8	..	..	701	
24th Punjab Infantry	7	..	..	575	
2nd (Prince of Wales' Own) Goorkahs.	7	..	..	501	
72nd Highlanders	23	787			2nd Infantry Brigade.
2nd Sikh Infantry (Punjab Frontier Force).	7	..	..	612	
3rd Sikh Infantry (Punjab Frontier Force).	7	..	..	570	
5th Goorkah Regiment (Punjab Frontier Force).	8	..	..	561	
2 | 60th Royal Rifles	21	616			3rd Infantry Brigade.
15th Sikhs	10	..	..	650	
4th Goorkah Regiment	7	..	..	637	
25th Punjab Infantry	8	..	..	629	
	274	2,562	7,151		

These numbers were, ultimately, slightly increased by the discharge of sick men from hospital, as will be seen from the figures given in the Appendix.

The constitution of the command may be described as that of a force consisting of an infantry division of 3 brigades of 4 battalions each (viz., 1 British and 3 native battalions), a brigade of cavalry

consisting of 4 regiments (1 British and 3 native regiments), and an artillery command of 3 batteries of mountain artillery.

The infantry division was complete in itself, with the requisite Staff, the cavalry brigade working independently, and its commander reporting direct to Field Force Headquarters. Batteries of artillery were attached to infantry brigades.

The determination to dispense with wheeled artillery has given rise to much comment; the experience previously gained by Sir Donald Stewart and Sir Frederick Roberts made them, however, of one mind with regard to this important point, and it is certain that had even horse artillery been taken, it must have seriously delayed the march. The object placed immediately before the General was the relief of Khelat-i-Ghilzai and Kandahar, and it was essential to aim at the extreme of mobility.

It is beyond question, that whenever Afghans have been possessed of wheeled artillery during military operations, they have been so hampered by their guns as to be easily vulnerable, and in mountain warfare generally, a commander will gain less by the possession of guns, other than mountain guns, than he will lose by having his march restricted to regular roads. The important part, however, played during the Battle of Ahmed Khel, in April last, by a battery of horse artillery, a light field battery, and a heavy field battery, when scores of fanatics were killed by case-shot fired from the 9-prs., and when well directed shell from the 40-prs. checked a turning movement undertaken by the enemy's horsemen, should not be forgotten. We may well be proud of the work our gunners did on that day, and acknowledge that the 1,300 rifles which formed the fighting line of infantry could scarcely have withstood the charge of 3,000 fanatic swordsmen, if they had not been supported by field artillery. The movement of Sir Donald Stewart's Force, when he marched from Kandahar to Kabul, was, however, regulated by the pace of the heavy guns which accompanied it. Its first objective was Ghazni itself, and the possession of wheeled artillery was essential to its purpose. It would have been impossible for 40,000 of the enemy to have collected and to have delivered an attack, such as was made at Ahmed Khel, against troops moving as rapidly as did those under Sir Frederick Roberts' command, the essential qualities of the force he led to Kandahar being mobility and striking power.

The possession of field artillery by Ayub Khan was well known, but it was rightly understood that he could not, with any advantage to himself, advance his artillery on the Kabul side of Kandahar, and it was confidently anticipated that the guns belonging to the Kandahar garrison might be available for use in operations carried on near the city itself, or to the west of it.

The absence of companies of sappers was met by the employment of the 23rd Punjab Infantry (Pioneers), a regiment of Musbi-Sikhs, trained to all practical engineering work, and which furnished 700 rifles to the fighting line; there was no intention to delay at Ghazni, if that place were occupied, and whatever road-making might be required to facilitate the movement of a force so lightly equipped, could

be performed by the infantry; a small reserve of engineer equipment was, however, attached to one of the infantry brigades.

The preponderance of Sikhs and Goorkahs in the native portion of the force is to be noticed; soldiers belonging to these races were designedly chosen to operate against the Pathan army of Ayub Khan; it happened, however, that particular native regiments, in which there were a large number of Pathans, had already been very frequently engaged, and as previously explained, they were not in consequence detailed to accompany the force.

Equipment.

Tables given in the Appendix detail the allowance of camp equipage, equipment, baggage, &c., considered sufficient for the several arms, as also the number of followers, sick carriage and transport animals. It is enough here to say that, without endangering efficiency, everything was reduced to the lowest possible limit, and that, for the object in view, the allowance was found sufficient, though the troops detained in the field for some time after arrival at Kandahar suffered a measure of hardship. In communication with Army Headquarters at Simla it was arranged that articles of clothing and equipment likely to be required after arrival at Kandahar, should be forwarded at once to Sibi for despatch, as soon as possible, to the front; these were chiefly ammunition, boots, shoes for Highlanders, and native shoes for the native troops, socks and articles of warm clothing, reserves of medicines, &c. They reached Quetta too late to be of much service to the force.

Throughout the preparation carried on, the principle of regimental independence was maintained, and under brigade direction each regiment was made in itself complete.

Hospitals.

It is true that, with reference to medical arrangements, the plan of a general hospital system was applied in a modified form to brigades, but the constitution of brigades (there being one European regiment with each) resulted in the brigade hospital section being invariably attached to the European corps; with native regiments the hospital system was strictly regimental. Hospital sections had already been for some time associated with brigades, and the medical equipment generally was in a satisfactory condition. No reduction was made in the allowance of transport required for hospitals on the ordinary field service scale; they were, however, completed with a three months' supply of medicines, and with a sufficiency of stores and medical comforts; in arranging this, it was found necessary to adapt many articles of equipment specially for mule transport.

Supplies.

The question of supplies naturally caused considerable anxiety; it had, however, been ascertained, during Sir Donald Stewart's march from Kandahar, that sheep and flour could, though with

considerable difficulty, be procured throughout the whole extent of the route chosen, with the exception of some 30 miles lying immediately on the Ghazni side of Khelat-i-Ghilzai, provided only the march was executed with sufficient rapidity to prevent the inhabitants from secreting their grain and driving off their flocks. The crops of Indian corn throughout the country had reached the stage previous to ripening, when the grain in the ear is admirable feeding for cattle, and is eagerly eaten by natives of the country; it was, therefore, reasonably assumed that forage could be obtained.

On this basis, the amount of supplies ordered to be taken was as under:—

For British troops in regimental charge.

Tea, sugar, rum and salt	for 30 days.
Preserved meat	for 2 days.
Flour (bread stuff)	for 5 days.
Flour for native followers	for 5 days.

For Native troops and followers in regimental charge.

Flour (atta)	for 5 days.
Dhall and salt	for 5 days.
Ghi, a small allowance, this article being purchased by the Commissariat whenever it could be obtained.	
Rum for native soldiers drinking spirits	for 8 days.
Sheep. Estimated requirements	for 10 days.

Commissariat Reserve:

Army food	500 lbs.
Lime juice	200 gals.
Preserved vegetables, all that were available, some	500 lbs.

Butcheries and bakeries were, with other necessary Commissariat establishments, detailed to regiments by the Deputy Commissary-General.

Reserves.

The Commissariat Reserve.

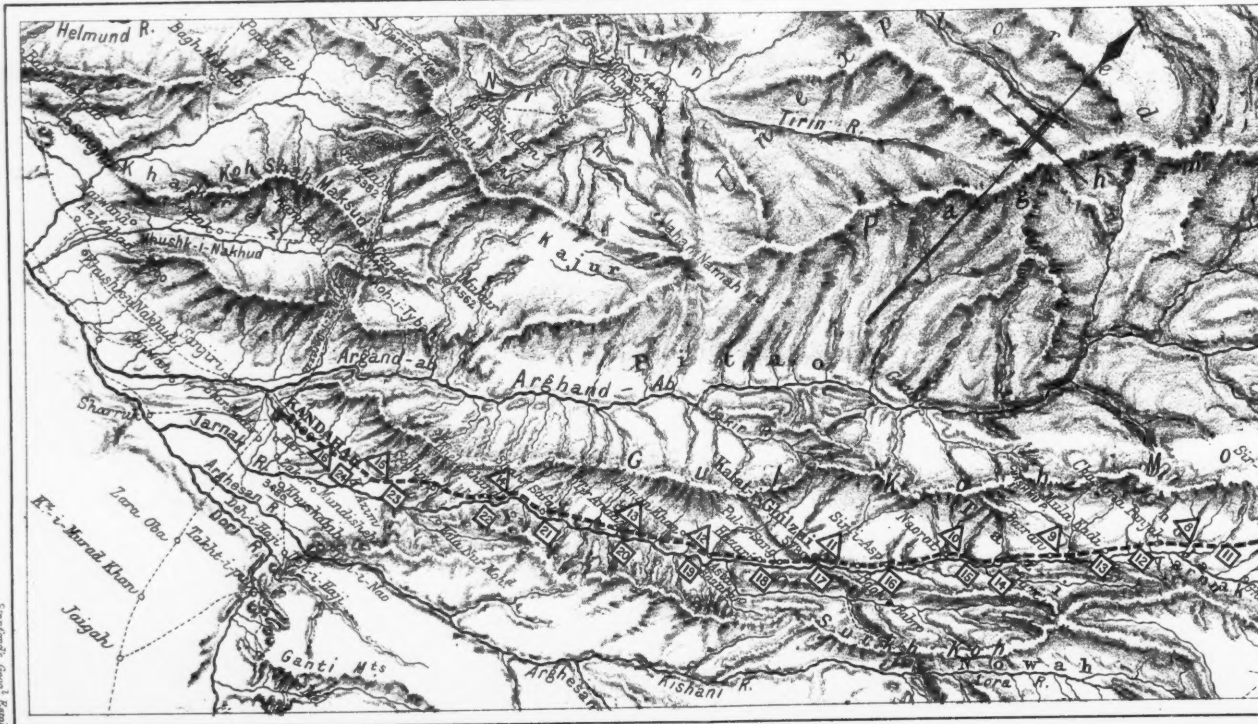
The Ordnance Park:

Containing the second reserve of S.A. ammunition, viz. 100 rounds per man;

the second reserve of British Mountain Batteries 30 rounds per gun;

and the Field Treasure Chest containing 3 lacs of rupees, constituted the only divisional reserves, with the exception of the small reserve of engineer equipment already referred to. These were all, however, allotted to and remained permanently attached throughout the march to the infantry brigades, which furnished the requisite loading parties, guards, &c., as a brigade duty. Under this system a brigade became a unit of movement, and to render it complete in itself for separate service at a moment's notice, a battery of mountain

KABUL
SHERPUR
Kabul R.
Logar R.
Logar R.
Maidan
Halmand
Shiniz R.
Ghazni R.
Mushaki
Takshin Hills
Naorozai Hills
Sir-i-Chashma
Zurmat
Kharwar



Stages numbered thus
Sir D. Stewart .... ▢
Sir F. Roberts .... △

Scale of English Miles
20 10 0 20 40

Stanford's Geog.l Estab.t

artillery was, from the outset, attached to it, and continued to be so associated.

Some few modifications in equipment sprang out of the use of mule and pony carriage, which may be noticed here, arrangements being made to provide a percentage of riding ponies as transport for sick soldiers and followers, as well as to carry the arms of the sick on mule pads provided with special fittings.

Carriage for Sick.

The sick carriage or bearer transport on which an Indian army must rely for the conveyance of sick and wounded is at all times a very special weakness, but during the movement to Kandahar the condition of the doolie-bearers with the force became a source of serious anxiety. When the march was ordered, a large number of bearers had been drawn away from Kabul towards Gandamak and Jellalabad, the sick and wounded from field hospitals being, as already stated, in movement towards the base; the march could not in fact commence until some of these men had been recalled to complete the full number required to accompany the force under orders of movement; they only returned to Kabul by the 7th August, and could consequently have no rest before starting.

A careful inspection of all troops and of all public and private followers was made, and every care was taken that no one who was considered physically unfit to undergo special hardship or fatigue should accompany the force. It followed, however, from the cause already stated, that the doolie-bearers, to a very great extent, broke down during the march.

The sick transport amounted to:—

Doolies.	Dandies.	Doolie-bearers.	Ponies for riding.	Donkeys.
115	321	2,192	286	43

Six camels were detailed specially for the conveyance of certain equipment which could not be adapted for mule transport.

Transport.

The transport available at Kabul in the beginning of August was, for the most part, in a very high state of efficiency; the major portion of it had for some time been placed in regimental charge, and had been worked regimentally with success. Officers, both European and native, had been accustomed for several months to the duties of controlling and caring for transport animals, and the troops had been trained to appreciate their value; it was, therefore, only necessary, before movement commenced, to reject and replace such as were not considered fit to undergo the arduous march in prospect, to complete the numbers required by each corps previous to movement, to furnish carriage for the ordnance and engineer parks, the Commissariat reserve, &c., and to arrange for a reserve of 10 per cent. of mules and ponies. The number of animals that left Kabul amounted to—

Yaboos (Afghan ponies).	Mules.	Indian ponies.	Donkeys.
1,589	4,510	1,244	912

The employment of donkey transport had been tried with success during the march of Sir Donald Stewart's Force from Kandahar to Kabul in April, and this class of carriage was found specially useful in the conveyance of provisions. Afghan donkeys will march with troops and carry loads of grain or flour averaging from 80 lbs. to 100 lbs. without any special strain. They keep pace with mules or ponies in a baggage column, as they avoid the frequent checks which retard the larger animals; they browse on the line of march, and find their own forage easily in the neighbourhood of camp; they were very easily controlled and cared for, and are on all accounts the most inexpensive transport in Eastern countries.

The several brigades were moved into camp at Beni-Hissar and Charasiab, in the neighbourhood of Kabul, on the 8th August, and on the 9th the march commenced. The more direct route to Ghazni, by the Maidan Valley, was not taken, but the march was directed by the valley of the Logar, in which the chance of supplies was greater; it was also thought possible, by adopting this direction, to keep the Afghans in doubt regarding the ultimate destination of the force. The route chosen during the first three marches leads directly towards the Shutargardan Pass and the Kuram Valley; the intention to march on Ghazni would not therefore be clearly indicated until the turning-point had been passed. Besides this, communication with Kabul by the Logar Valley was possible, whereas there had always been great difficulty in communicating through Maidan and Wardak. The latest news received from Kandahar previous to the departure of the force was of the 3rd August, on which date Ayub Khan was reported to be still 20 miles to the west of Kandahar. The troops under Lieut.-General Primrose's command were, however, shut up within the walls of the citadel and city, by a rising of the people of the district. It was known that the walls could scarcely be surmounted by assault, and that they could not be breached by field artillery; it was, therefore, reasonably assumed that the large garrison which held Kandahar could with ten light field guns and a heavy battery resist any attack which the Afghan army might make, and would be secure for so long a time as provisions held out. Nothing was known for certain about the amount of supplies at Kandahar, but it was hoped that, with the exception of live stock and forage, all articles were fairly plentiful. There was also some doubt about the water-supply of the city, but this, drawn from wells, proved to be abundant and good.

The route pursued as far as Ghazni was as follows:—

Marches.			
1. Beni-Hissar	to	Zaidabad	16 miles.
2. Zaidabad	„	Zergunshahr	13 „
3. Zergunshahr....	„	Padkao Rogani	16½ „
4. Padkao Rogani..	„	Ashrak or Amir Killa	10½ „
		Cross the Zamburak Pass...	7,000 feet.
5. Ashrak	„	Takia, in the valley of the Shiniz	12 miles.

Marches.

6. Takia (Haiderkhel).[1]	to	Shashgao	17 miles.
7. Shashgao	„	Ghazni	$12\frac{1}{2}$ „
		Cross the Sher-i-Dahan Pass	9,000 feet.
		Total	$97\frac{1}{2}$ miles.

Or an average daily march of $13\frac{1}{4}\frac{3}{4}$ miles.

N.B.—The route by Maidan is about 87 miles in length.

The first three marches led by the valley of the Logar, through a country fairly open, though brigades were necessarily restricted to one road. In forming the column of march the lead was taken by brigades in rotation, and similarly the leading position in brigade was allotted to corps according to roster. The plan adopted in marching is best indicated by the following extracts from the order books:—

" Camp Zergunshahr,
" No. 10. " August 10th, 1880.

" When two or more brigades march together, the following will " be the order of march:—

" 1. *Troops constituting the fighting line*, with the first reserve of " ammunition, rations and cooking pots for European regiments, " doolies and dandies.

" 2. " Field hospitals.
" Ordnance park.
" Treasure.
" Engineer park.
" Led horses.
" The baggage of brigades massed and moving in the order of " movement of corps.

" 3. The rear-guard, as may be detailed.

" The baggage will be controlled in brigades by brigade Transport " Officers.

" All followers, with the exception of Officers' syces and cooks " accompanying British regiments, will remain with the baggage, and " will be under the control of the Provost-Marshal and his establish- " ment.

. . . . . .

" No. 15.

" Rouse to-morrow at 2.45 A.M.

" Brigades will march at 4 A.M.

" The Cavalry Brigade and 2nd Infantry Brigade will cross the " river at Hissarak, and march *viâ* Uni Saydan and Deh Moghlan to " Baraki-Barak, and encamp on the sloping ground overlooking, and " to the west of the village; their supplies to be drawn from the " villages above named.

" The 1st and 3rd Infantry Brigades will march in columns of " brigades, the 2nd Brigade crossing the small Kotal (pass) to the

[1] A list of the marches from Haiderkhel to Kandahar accompanies the map at the end of the paper.

"west of the camp and marching through Dadu Khel towards His-
"sarak.

"These brigades will march on parallel lines to the rising ground
"situated to the left of Padkao Rogani, distance 15 miles.

"Supplies for these brigades will be drawn from Padkao Rogani
"and Baraki-Rajan."

NOTE.—In such movements, although halts were ordered at regular intervals, it was found impossible to assimilate the pace, and preserve a regular rate of marching. When the Highlanders led the column, the Goorkahs were worn out by their efforts to keep up, and when the Goorkahs were in front, the pace became generally so slow as to fatigue the Europeans and the Sikhs, yet it was very important for Brigade Commanders to strive at a uniform rate of marching, and to adhere to the halts of ten minutes ordered at the end of each hour of march, as well as the breakfast halt of twenty minutes, fixed for 8 o'clock.

The movement through the defile known as the Tangi Wardak, by which the Logar and Shiniz when united find their way from the Wardak country to the Logar Valley proper, was effected with some difficulty, and the passage of the Zamburak Pass threw hard work upon the troops; owing to the absence of wheeled artillery and to the equipment of the entire force with mule and pony transport, no halt was, however, found to be necessary, either before or after the passage of this difficult piece of country. It had been anticipated that the passage of the Zamburak would be disputed; but neither here nor at the Sher-i-Dahan Pass was any opposition offered; the road over the latter is open and easy, and had, only a few months previously, been made practicable for the movement of heavy field guns. It will be readily understood that the collection and distribution of food, fuel, and forage, together with the establishment of markets within the limits of each brigade, where the inhabitants might find a sale for articles of supply, necessitated an elaborate system; the work of marching, camping, and supply rested, however, with no inexperienced soldiers; it was not very often during the entire length of the march to Kandahar that the British troops had to substitute flour-cakes (chupatties) for the regular bread ration, and no instance was brought to notice in which either a soldier or a follower failed to receive his ration. The principle applied in marching, in the formation of camps, as well as in the distribution of supplies and forage, was that each individual in the moving body should, as far as possible, depend upon his own exertions. In the formation of camps, the positions of brigade and regimental headquarters were, as far as was practicable, the same on each day, and were readily recognized; everything was left to regimental agency, and action in brigade was rarely necessary. A sufficiency of wood for the bakeries attached to British regiments was obtained with the greatest difficulty; the country is almost devoid of trees, and, except near villages and when it was possible to take the roofs off the houses, strong fatigue parties had to be told off to dig up the roots of the "southern-wood" and shrubs which fortunately abounded. A fair price was invariably paid for the

wood, and it was found that the inhabitants were, for the most part, willing to sell their houses; the native troops were, however, most frequently reduced to collecting the roots of the "southern-wood," and on it the followers depended for fuel.

After leaving the Logar Valley, water was, as a rule, only found at more or less extended intervals. This caused much difficulty in selecting the site of each day's encampment, with due regard to the length of the march and the presence of a sufficient supply of water. Long stretches of desert had often to be traversed without a drop of water, causing great inconvenience and suffering to man and beast marching under a burning sun. Fortunately, when a stream was found, the water, as far as Khelat-i-Ghilzai, was generally good and fairly plentiful. The climate showed great variations of temperature between day and night, at times as much as 80°. The sun was throughout the day very powerful, and the nights comparatively cold, until Kandahar itself was nearly reached. This caused great inconvenience to the troops, who had to march in the same clothes when the thermometer was nearly at freezing point as when it reached 110°. They also suffered greatly from constant sand storms, and from the suffocating dust raised by the column on the march. It must also be noticed that the moon was in its first quarter when we left Kabul; the comfort derived from its light after a weary day's march, and in the preparation for an early start, cannot be over-estimated.

Ghazni was reached on the 15th of August. The tribal gatherings, which had been encouraged to fanaticism by Mushk-i-Alam during the early period of the campaign, and which had resisted Sir Donald Stewart's march, had long since dispersed; the faction which acknowledged Mahomed Jan as chief had accepted temporarily the Amirship of Abdul Rahman, and such of the Chiefs as professed themselves adherents of the Yakub Khan party had proceeded to join Ayub Khan at Kandahar. The temporary Governor of Ghazni professed to welcome the General, and promised to furnish supplies; it was, however, necessary to employ foraging parties to obtain them; there was everywhere a sullen objection made to provide what was required, and markets were established in camp with the greatest difficulty. The rapidity with which the transfer of 10,000 troops from Kabul to Ghazni had been effected had, in fact, prevented the possibility of combinations and consequent resistance, and all idea of organized opposition was abandoned, yet fear only prevented overt acts of hostility on the part of the inhabitants. As a matter of fact, the Ghazni district, and the district of Mukur which adjoined it, had too recently suffered in the battle of Ahmed Khel for the inhabitants to run the risk of further punishment.

N.B.—On the battle-field of Ahmed Khel a ziarat, to the memory of 1,100 martyrs, indicated the losses they had sustained.

Throughout the provision of the required daily supply caused considerable anxiety and entailed additional work on the troops and transport animals, many of whom had daily to be sent long distances

to bring in food after the march was over. As far as the watershed dividing the head waters of the Ghazni and the Tarnak Rivers, the route now followed the Ghazni River by a gradual rise, the country being far more open than hitherto, some modification of the order of march became therefore possible; considerable experience had already been gained, and marches of unusual length were henceforward made.

On the 16th August a march of 20 miles was accomplished, some of the brigades covering from 22 to 23 miles in their day's journey.

The orders for movement were as follows:—

"Ghazni, 15th August, 1880.

"The force will march to-morrow to ground beyond Nani, which "will be pointed out on arrival.

"The rouse will sound at 2.45 A.M., and brigades will move at "4.15 A.M.

"The movement will be covered by the cavalry brigade at a dis- "tance of 5 miles in advance of the infantry column.

"The Officer commanding the cavalry brigade will detach one troop "to accompany the 1st Brigade of Infantry.

"The baggage of the cavalry brigade will move after the infantry "column has passed, and take place in rear of it, but in advance of "the baggage of the infantry.

"The doolies of the cavalry will head the cavalry baggage; spare "horses of cavalry, led chargers of Officers, and all followers of the "cavalry brigade will remain with the baggage.

"The Infantry Division will march in the following order:—

"The 2nd Infantry Brigade.
"The 3rd Infantry Brigade.
"Field hospitals.
"Baggage of the 2nd Brigade.
" " " 3rd Brigade.
" " " 1st Brigade.
"Ordnance.
"Treasure.
"Commissariat reserve.

"The 1st Infantry Brigade will form the rear-guard, the Officer "commanding the brigade ordering the time of its march."

The manner of covering the movement rested with the Officer commanding the cavalry brigade; as a general rule the distribution of the brigade, however, consisted in the front being covered by two regiments, while a regiment moved on either flank at an average distance of a mile from the infantry column, the flanking regiments detaching one or more troops to the rear-guard. The hilly nature of the ground rendered it impossible for cavalry to be worked at a greater distance.

The method of such marching as was now put in practice is not easy to describe; it combined the extreme of freedom in movement, with carefully regulated halts, and the closest control in every portion of the column; it employed the individual intelligence of each man composing the masses in motion, and called on all for exertion in

overcoming the difficulties of the march, in bearing its extraordinary toil, and in aiding the accomplishment of the object in view. Once movement had commenced, the animals of the baggage column, moving at different paces, were checked as little as possible; the large number of Officers detailed for baggage duty reduced confusion to a minimum, and secured a pace in marching that could not have been anticipated, the baggage animals reaching camp for the most part very soon after the arrival of the troops.

The utmost effort to systematize the march could not, however, prevent the rear-guards from being detained upon the road, covering and aiding the march of a weary following, pressing forward the feeble amongst the cattle, shifting loads and rendering such assistance as was required. Assuming that the march commenced daily at 4 A.M., the rear-guard seldom left camp before 7 A.M., and only reached the next encampment shortly before sundown. The actual length of the column of march, by the shortest computation, amounted to from 6 to 7 miles.

To appreciate the endurance of the troops under the circumstances detailed, or to understand the very high order of discipline they maintained, it seems almost necessary to have seen them at work, and to have witnessed the cheerful alacrity with which they responded to every call, refusing under all circumstances to acknowledge even that they were fatigued.

If it be realized that 10,148 troops, 8,143 native followers, and 11,224 animals, including cavalry horses, composed the column in movement, that the daily supply for all these was drawn from the country after arrival in camp, that food was regularly distributed to every individual, and cooked with fuel brought in from a distance, that bread was issued almost daily, and that ample forage was provided, the performance of the next eight days will be allowed to rank high in the annals of marches.

On the	16th	August,	the	force	marched from Ghazni to Yerghalta, 20 miles.
,,	17th	,,	,,	,,	Yerghalta to Chardeh, 12 miles.
,,	18th	,,	,,	,,	Chardeh to Kerez-i-Oba, 16½ miles.
,,	19th	,,	,,	,,	Karez-i-Oba to Mukur, 14 miles.
,,	20th	,,	,,	,,	Mukur to Panjak, 21 miles.
,,	21st	,,	,,	,,	Panjak to Gajai, 18 miles.
,,	22nd	,,	,,	,,	Gajai to Baba Kazai, 16½ miles.
,,	23rd	,,	,,	,,	Baba Kazai to Khelat-i-Ghilzai, 16½ miles.

Making a total distance of 134½ miles in eight days, or $16\frac{13}{16}$ miles daily.

Although a hostile population hovered on all sides ready to attack stragglers, but three native soldiers were cut off from the column between Kabul and Khelat-i-Ghilzai; there were two suicides among the troops, and the number of followers unaccounted for at the end of the march was less than 40, and many of those, being Afghans or Hazaras, had deserted.

Each day careful reports regarding the health and actual condition of troops and followers were submitted to the Lieutenant-General; with reference to the facts brought to light by these, it may be observed that for some days after the march commenced, the daily increase in the number of men reputed to be footsore or unable to march, through weariness or general debility, was calculated to make the General hesitate in maintaining the rate of marching; the limit of the strain, however, seemed to have been reached when the long march out of Ghazni was accomplished, and from that time, many footsore men rejoined the ranks; it was, however, evident, that although the troops were in great form, the bulk of the followers, and more especially the doolie-bearers, could not hold out much longer.

Every baggage animal that could be so utilized was employed in aiding the weary and footsore, and in bringing them into camp, but the apathy of despair led many a worn-out man of the native following to refuse all exertion, and the duty of the rear-guard in pressing forward the stragglers was often arduous and painful.

In addition to the daily ration, a tin of pea-soup[1] was issued to every two British soldiers, on the 18th August, and on subsequent days.

Extra rum was issued to all soldiers drinking spirits, both British and native, three times, and an extra ration of meat to those men who did not drink rum, a meat ration of 2 chittacks, or 4 ounces, was also authorized for all followers whenever a sufficient number of sheep could be obtained. A regular issue of lime-juice was also ordered for all ranks.

Intelligence.

No account of operations in an enemy's country would be complete which did not refer to the method adopted in gaining intelligence.

During the campaigns recently conducted in Afghanistan, the Commanding General has, on nearly all occasions, been invested with supreme political authority, and the Political Department, which is a branch of the Foreign Department of the Government of India, has been directly under his control. Excepting where our troops have been in actual contact with the enemy, the Political Department has been the real department of intelligence; its Officers, chosen for their knowledge of Persian or Pushtoo, or on account of special experience in dealing with frontier tribes, were assisted by native Officers and soldiers of tried fidelity, who would otherwise have been employed under a chief of military intelligence. The duty of obtaining complete intelligence regarding the people and general politics of the

[1] This pea-soup was commonly taken before the march commenced.

country thus devolved on the Officers of the Political Staff, who were also mainly engaged in assisting the Commissariat to procure supplies. In addition to this agency, however, and to the regular patrolling of the country by cavalry, what I would term purely military intelligencers were encouraged to acquire information under regimental arrangements, and much was thus done at Kabul, in such regiments as the Corps of Guides, the 5th Punjab Infantry, the 28th Punjab Native Infantry, and in the cavalry, to ascertain what was really going on in the country. An Officer of the Quartermaster-General's Department was also specially entrusted with the duty of gaining intelligence through Afghan agents.

The information obtained daily in the Political Department, and by the other means detailed, was compiled in the Quartermaster-General's office, and was submitted for the General's information, after which it was circulated to brigades for the information of the Staff and commanding Officers. This system worked well, and allowed of all information being properly sifted, as all intelligence acquired by military agency was at once communicated to the Political Staff.

During the march from Kabul to Kandahar, there was no departure from the plan thus outlined, military and political Officers being in the closest accord with regard to the acquisition of intelligence; there was, however, an efficient body of cavalry to cover the movement, and directly the presence of an organized body of the enemy was ascertained, recourse was had to reconnaissance.

It happened that copies of the maps which had been prepared during the march of Sir Donald Stewart's Force had not in August reached Kabul from India; tracings of the original sheets were, however, supplied to brigades, and were copied in regiments; so that all Officers could be expected to have a general idea of the country.

It may here be noticed that the great perfection to which the practice of army signalling had been brought made the heliograph a very important aid in the communication of intelligence. Under the direction of the late Captain Straton, Superintendent of Army Signalling at Kabul, the trained signallers of the force were constantly employed, and by the judicious use of the heliograph on many occasions, the troops, both cavalry and infantry, were spared fatigue, the several brigades being constantly in communication by signal. I refer to this subject under the head of "Intelligence," as the value of this agency can only be fully appreciated when it is applied in the field, and particularly during operations in mountainous countries, to convey rapidly information of importance. Later on, it will be seen how much depended on the working of the heliograph between Kandahar and the camp in the Tarnak Valley, on the 27th August, but the benefits conferred on the Kabul Field Force, by its staff of army signallers under their gallant leader, cannot be forgotten.

At Panjak, on the 20th August, Sir Frederick Roberts received a letter from Khelat-i-Ghilzai, dated the 18th idem. Colonel Tanner, who was in command, stated that all was well with the garrison, and that the neighbouring country was quiet; he had received news from Major-General Phayre, C.B., from Quetta, dated the 12th August, to

the effect that he hoped to reach Kandahar, not later than the 2nd September, with a large force of cavalry, artillery, and infantry.

On the morning of the 21st August, communication by heliograph was established with Khelat-i-Ghilzai, distant 33 miles, and on that day, the agents of the local Governor, who acted under Colonel Tanner's direction, came out to meet the force, and to assist in obtaining supplies; wood and other articles required were also sent out from the fort to Baba Kazai, under an escort furnished by the 2nd Biluch Regiment. The following message was received by heliograph: "I have sent in to-day's letter detail of sortie made from Kandahar. "Our loss, 8 Officers, including General Brooke, killed, 5 wounded; "200 men killed and wounded. Troops in Kandahar in good spirits, "and anxious to be attacked, as they are secure." The letter received from Colonel Tanner informed the General that supplies at Kandahar were abundant, with the exception of forage, which could, however, be made to last until the 1st September. Messengers were despatched from Khelat-i-Ghilzai to Chaman on the 23rd August, with letters to Major-General Phayre, giving him full particulars regarding the march of the force, and the probable time of arrival at Robat, at which point it was hoped that communication with the column marching from Quetta might be established in view to a combined movement on Kandahar being arranged.

On the 24th August the force halted at Khelat-i-Ghilzai. Before leaving Kabul, Sir Frederick Roberts had received no instructions with reference to the disposal of this fort and outpost; he, however, considered it unadvisable to leave an isolated garrison behind in a position to which supplies must be subsequently forwarded with great difficulty; besides which such a garrison, however capable of maintaining itself in the fort, could not attempt offensive action or influence operations against Ayub Khan, and must therefore prove a source of embarrassment. Fortunately the troops at Khelat-i-Ghilzai were equipped with transport for movement and possessed European supplies for ten days, besides reserves of preserved meat, soup, and vegetables, which were very useful to the Kabul-Kandahar force. Sir Frederick Roberts decided that the garrison of Khelat-i-Ghilzai should accompany the force to Kandahar, and arranged to entrust the fort to Mahomed Sadik Khan, a Tokhi Chief, who was willing to hold it in British interests.

By the route which follows the valley of the Tarnak, and is that ordinarily taken, Kandahar is 86 miles from Khelat-i-Ghilzai; it may, however, be reached by roads which pass along the Argandab and Argastan Valleys that lie north and south of the Tarnak Valley and run parallel to it. On arrival at Khelat-i-Ghilzai, Sir Frederick Roberts was, therefore, called upon to consider the possibility of the Afghan Army, under Ayub Khan, endeavouring to pass clear of his line of march, and make for Ghazni by either of the alternative routes. The retention or abandonment of Khelat-i-Ghilzai in no way bore upon this question, as the fort could be passed by either of the lines under consideration at a distance of some miles, and cavalry and infantry could move by easy passes to join the main Ghazni road

near Panjak; but, in the absence of all knowledge regarding what had happened in the neighbourhood of Kandahar since the sortie of the 16th August, it devolved on the General to decide whether from this point he should keep his force intact and continue his march by the valley of the Tarnak, or detach some portion of his troops by the Argandab, to meet and check a possible move on the part of Ayub Khan, whose best policy it appeared to be to avoid an encounter and gain possession of Ghazni.

In January, 1879, when Sir Donald Stewart moved by the Tarnak Valley from Kandahar to Khelat-i-Ghilzai, with a division of all arms, it had been decided to send reconnoitring columns to pursue the alternative routes that existed, the character of the valleys of the Argandab and the Argastan was therefore well known, and the routes passing through them had been fully reported on. No doubt existed regarding the impossibility of moving wheeled artillery by the Argandab Valley; it was, therefore, certain that unless Ayub determined to abandon his guns he must be encountered in the neighbourhood of Kandahar itself, or be overtaken if he endeavoured to carry his artillery with him in a retirement towards Herat. Apart from the relief of Kandahar, it was imperative to inflict upon Ayub Khan a defeat which would satisfactorily re-establish the superiority of our arms, and the acquisition of the enemy's artillery would mean little if he avoided a battle. Under these circumstances, the General made up his mind to march as rapidly as possible, by the Tarnak Valley, to a position from which communication by heliograph might be established with Kandahar, in order that satisfactory information regarding Ayub's movements might influence his further march.

On the 25th August, the force marched to Jaldak, 15 miles; and on the 26th marched to Tirandaz, 15 miles.

At Tirandaz a letter was received from Kandahar dated the 25th, which conveyed the intelligence that the rumour of the arrival of the Kabul-Kandahar Field Force at Khelat-i-Ghilzai had caused Ayub Khan to change his position; that, on Monday night, the 23rd, the villages east and south of Kandahar had been abandoned by the mixed garrisons of Ghazis and regulars who had been entrusted with the investment of the city, and on the 24th Ayub had struck his camp and moved to a position on the Argandab River between Baba Wali and Shaikh Chala, due north of the city; he was reported to have with him 4,000 (regular) infantry, 2,000 cavalry, and many Ghazis, his artillery being stated to consist of six 12-pr. guns, two 9-pr. rifled, four 6-pr. smooth-bore guns, and one 4-pr.

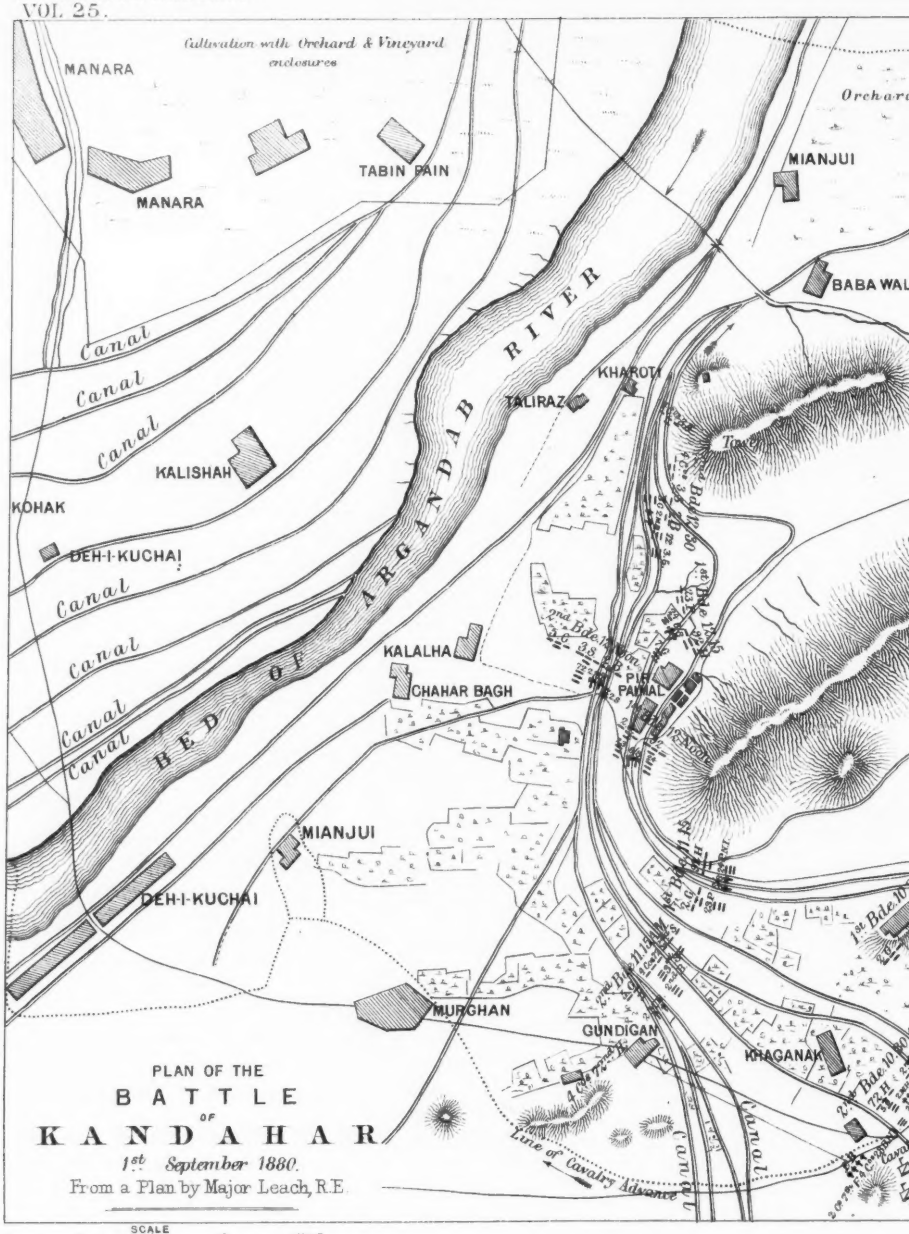
Orders were then issued for two regiments of cavalry to march the following day to Robat, distant 36 miles, for the purpose of opening direct communication with the citadel of Kandahar, the remainder of the force being directed to move to a point about half-way to Robat. It was further arranged that in the event of information being received that Ayub was relinquishing his position and carrying his infantry and cavalry towards Ghazni by the line of the Argandab, a movement should be made to intercept his march. The camp of the

infantry division was, on the 27th August, 39 miles from Kandahar, and from the position in which it was placed, the Argandab Valley could be reached in two marches of 17 miles each, by a road passing through a valley known as the Bori Valley, and emerging in the district of Dallah, about 40 miles above Kandahar upon the Argandab River. Some 7,000 troops of arms were held in readiness, in the lightest of marching order, to proceed on the 28th August by this line, it being intended that, if the movement was undertaken, the two regiments of cavalry thrown forward to Robat should cover the movement, and strike the Argandab some miles nearer to Kandahar than the point where the infantry would debouch. The field hospitals and non-effectives, baggage, &c., would, at the same time, have been advanced slowly towards Kandahar, under an escort of not less than 2,500 infantry, 2 field guns (belonging to the Khelat-i-Ghilzai garrison), and a regiment of cavalry, with the idea that they might be placed in an intrenched position at or near Robat during the conduct of whatever operations might follow.

At 1 o'clock on the 27th, heliographic communication with Kandahar was established at Robat, from which point signals were flashed to the infantry camp. It was then ascertained that the Afghans were still in position behind the Baba Wali Pass, overlooking the city, and that Ayub Khan was not credited with any idea of flight, it being stated that the Ghazis whom he had assembled would force him to fight.

On the morning of the 28th of August, the entire force was brought together at Robat, regular communication with the city having been opened the previous afternoon, when Lieutenant-Colonel St. John and other Officers arrived in the cavalry camp under escort of two squadrons of cavalry. It was ascertained that, although the investment of Kandahar was at an end, and the garrison were free to move about the villages near the walls, or even further in the direction of Robat, the position occupied by Ayub Khan was perfectly concealed. The information obtained regarding his dispositions amounted to little or nothing; it was, however, clear that the Afghan Army held a strong defensive position, and evinced no intention of abandoning it without a struggle. This being the case, Sir Frederick determined to halt at Robat for one day, troops and followers being much in need of rest. The entire force encamped at Momand on the 30th August.

While at Robat Sir Frederick Roberts received a letter from Major-General Phayre which put out of the question all hope of co-operation by the force advancing from Quetta, the leading brigade being still occupied in the passage of the Khojak Pass. The difficulties which had been encountered in moving troops by rail through Scinde at the end of July, and in marching them through the country intervening between Sibi and Pishin, can only be referred to in this paper to explain the unavoidable delay in General Phayre's movements. The hardships and privations undergone by the troops advancing from Scinde were of no ordinary character; the patience they exhibited,


Cultivation with Orchard & Vineyard enclosures
MANARA
MANARA
TABIN PAIN
MIANJUI
BABA WAL
Canal
Canal
Canal
KALISHAH
KOHAK
DEH-I-KUCHAI
Canal
Canal
Canal
Canal
BED OF ARGANDAB RIVER
KHAROTI
TALIRAZ
KALALHA
CHAHAR BAGH
PIR PAIMAL
MIANJUI
DEH-I-KUCHAI
MURGHAN
GUNDIGAN
KHAGANAK
Line of Cavalry Advance
Canal
PLAN OF THE
BATTLE
OF
KANDAHAR
1st September 1880.
From a Plan by Major Leach, R.E.
SCALE
MILE

THE MURCHA PASS
KHESHKI
Orchard enclosures
MAZRA
AYUB KHAN'S CAMP
Final Dispositions
2nd Bde. 1 P.M.
BABA WALI
1st Bde. 1 P.M.
3rd Bde. 1 P.M.
BACK MURCHA PASS
Line of Cavalry return
Canal
AHMAD KHAN
GUNDI MULLA SAHIB DAD
1st Bde. 10 A.M.
KALACHA-I-HAIDAR
Canal
PICQUET HILL
SHUTARGARDAN
CANTONMENTS
2nd Bde. 10 A.M.
3rd Bde.
6/RA
MEZ HILL
ABASABAD
HEAD QUARTERS
Canal
Canal
Canal
Cavalry Bde.
SARPUSA
R.E. Qrs
Head Qrs. Staff
CITY OF KANDAHAR
Stanford's Geog.l Estab.t

and the eagerness with which they sought to overcome all obstacles, are worthy of remembrance!

The water supply to the west of the city was at this time in the enemy's possession, and it became necessary to organize the march of the 31st so as to gain the karez which furnished it, as well as to secure a position for camps covering the city itself, and within striking distance of Ayub's intrenchments.

The force moved from Momand on the morning of the 31st August, two brigades of infantry leading the advance, while the cavalry covered the baggage on either flank, and the remaining infantry brigade formed a rear-guard. The direction of the march cleared the city on the south. After marching 12 miles, however, a halt was made near the Shikarpore, or south gate of the city, where, in communication with the General Officer commanding at Kandahar, arrangements had been made for the troops to breakfast. At 10 o'clock the leading brigades were pushed forward, the baggage remaining massed under the city wall, and a position stretching from the range immediately above Old Kandahar through Karez Hill and what is known as Picket Hill, was occupied. From this the enemy could be observed in occupation of the Baba Wali Pass, with cavalry pickets thrown forward upon a low ridge overlooking the cantonment and the city. The ground taken up for our camps was selected as being outside the limit of range from the pass itself, though later on more than one shell from the enemy's rifled guns at the Baba Wali fell within camp limits. The dispositions of the enemy were entirely concealed; as soon, therefore, as the ground for camps had been allotted, and pickets were thrown out covering the water supply, a reconnaissance was ordered. The 3rd Bengal Cavalry, the 15th Sikhs, and two guns 11 | 9 R.A., were detailed for this duty, under the command of Brigadier-General Hugh Gough, C.B., V.C. The reconnoitring column moved out, about 1 P.M., from the left of the line of pickets towards some high ground immediately above the village of Gundigan; here the infantry and guns were halted while the cavalry advanced for a mile or a mile and a-half, clearing, as far as possible, the orchard ground which shut in Gundigan itself, and emerging on a stretch of turf directly in front of, and distant about a mile from, the village of Pir Paimal, where the enemy appeared to be strongly intrenched. This movement at once drew the fire of the enemy's artillery, while the dry water-channels forming an intrenchment along the whole front of this position rapidly filled with men assembling. As soon as the enemy's fire along his entire line had been drawn, the cavalry fell back very cleverly, taking shelter under the orchard walls, and two companies of infantry thrown forward to cover this withdrawal became slightly engaged with the enemy's skirmishers now entering the orchards, while the mountain guns were brought into action at a range of about 1,800 yards from the enemy's artillery in front of Pir Paimal. At this time the Afghans were observed to be pressing rapidly into the orchards in front of Gundigan, and as soon as the cavalry had passed in rear of the line, retirement was ordered. The cavalry movement had been carried out with great coolness and

with singular good fortune, no casualty having, up to this moment, occurred. Following the cavalry, the guns were then withdrawn towards the line of pickets under escort of two companies, while six companies of infantry held the Gundigan Hill. The instant these fell back, the enemy in large numbers occupied the ground just vacated, and took possession of the village itself; the guns were then pushed forward to the left picket, and one of them came immediately into action, the companies which had served as escort being brought back in support of the companies returning from the hill, which were steadily pressed by an enemy momentarily increasing in strength. The enemy eventually assembled in such large numbers, and endeavoured so persistently to follow up the reconnoitring column, that the whole of the troops in camp were placed under arms, and about sunset firing was taken up along the whole line. The shooting of the Afghans was, happily, very indifferent, only ten casualties being reported. The reconnaissance had been made with previous knowledge of the ground, and with positions noted on a well-executed map, the information obtained enabled the Lieutenant-General to form his plans for the next day's operations. The enemy's position had been discovered to lie too close to that held by the force for him to be left for many hours undisturbed, and an attack was at once decided on.

As soon as the General's plans were formed, about 8 P.M., Officers commanding divisions and brigades, with their Staff and the Officers next in rank in brigades, were ordered to assemble at Headquarters at 6 A.M. on the 1st, and a line of field telegraph having been erected between Headquarters and the city, Lieut.-General Primrose, commanding the Kandahar garrison, was also communicated with, orders were issued for troops to breakfast at 7 A.M., and to prepare a day's cooked ration, for camps to be struck and packed, and for the entire force to be under arms at 8 A.M.

On the morning of the 1st September, Lieut.-General Sir Frederick Roberts communicated personally to commanding Officers his plan of attack, and the following distribution of troops was made before the advance was ordered.

The Infantry Division Kabul Field Force was drawn up in rear of Picket and Karez Hills, and in prolongation to the left as far as Chil-Zina (immediately below the range which covers Old Kandahar). The 1st and 2nd Brigades were to form the column of attack, and were massed behind Karez Hill, the 3rd Brigade, which constituted the reserve, being extended to the left.

The Cavalry Brigade Kabul Field Force, with E | B Royal Horse Artillery (four guns), two companies 7th Fusiliers, and four companies of Bombay Native Infantry, under the orders of Brigadier-General Hugh Gough, C.B., V.C., were drawn up in rear of the left, the order to General Gough being that if, when fire was opened, he found his front clear, he should push forward the infantry and guns to occupy the position above Gundigan, which had been so useful during the previous day's reconnaissance, the cavalry being pushed to the bed of the Argandab, from which point the enemy's line of retreat to Girishk could be easily closed, and that which led to Kakrez might be

threatened. The cavalry brigade was ordered to carry two days' cooked rations.

The troops of the Kandahar Garrison, under the orders of Lieut.-General Primrose, C.S.I., were directed, after sufficient guards for the city gates had been detailed, to move towards the positions held by the infantry destined to attack. C | 2 Royal Artillery was, however, ordered to join the 1st Brigade Kabul Field Force, to which 6 | 8 R.A. (screw guns) was also attached. Brigadier-General Burrows' Brigade, with 5 | 11 R.A. (four 40-prs.), and the cavalry of the Kandahar garrison, were meanwhile allotted to a position to the north of the old cantonment, and under shelter of some high ground actually in the enemy's possession, from which point the guns were to shell the Baba Wali Pass, and cover the main design in the attack. The cavalry, under Brigadier-General Nuttall, being ordered to move to the right, and cover the approach to the city from what is known as the Murcha Pass, the extreme left of the enemy's position.

Shortly after 9 A.M. the dispositions above outlined were completed; it was, however, apparent that the enemy, regarding our withdrawal in reconnaissance, the previous evening, as a further success, were determined to act offensively. Gundigan was occupied in force by them early in the day, and the movement of the cavalry was consequently delayed until the main attack to be delivered by the infantry on the right should be developed. The very strong defensive position about the village of Gundi Mulla Sahibdad, some 1,400 to 1,500 yards from our line, was held, and all along the front, through the orchards and gardens which connected the two villages of Gundigan and Gundi Mulla Sahibdad, the enemy's skirmishers covered the movement of very large numbers from Pir Paimal towards our line. The Baba Wali Pass was crowded with Ghazis, and the regular cavalry of the enemy held the comparatively low ground in advance.

Already the enemy's shell were falling occasionally within our line, and a desultory fire from the gardens was aimed at the troops wherever they were visible, when, about 9.20 A.M., the 40-prs. opened against the pass. This signal was to initiate our attack, the object of which was the village of Pir Paimal. It was, however, necessary to dislodge the enemy from Gundi Mulla Sahibdad, and C | 2 R.A. and 6 | 8 R.A. being in position to shell this village, the 1st Brigade, under Brigadier-General Macpherson, C.B., V.C.,[1] moved directly against it, the 2nd

[1] *Troops of the Kabul Force Employed in the Attack.*

1st Brigade (Infantry), Brigadier-General Macpherson, C.B., V.C., Commanding.
92nd Highlanders.
2nd Goorkahs.
23rd Pioneers.
24th Punjab Native Infantry.
6 | 8 Royal Artillery (attached).

2nd Brigade (Infantry), Brigadier-General T. D. Baker, C.B., Commanding.
72nd Highlanders.
2nd Sikhs.
3rd Sikhs.
5th Goorkahs.

Brigade extending to its left and moving through the orchards, in connection with the 1st Brigade, until its left touched Gundigan. The 3rd Brigade was at the same time formed in support in advance of the village of Abasabad. The shell-fire of the batteries was very effective, but the enemy found cover in the underground chambers in the village of Gundi Mulla Sahibdad, which was carried by the 2nd Goorkahs and 92nd Highlanders in dashing style; the enemy, driven out, retired leisurely, however, many of them remaining behind to meet the bayonets of the 92nd. Meanwhile, the 2nd Brigade became engaged while clearing the orchards on the left; and it was here that Lieutenant-Colonel Brownlow, C.B., and Captain Frome, of the 72nd Highlanders, lost their lives. The enemy's right at Gundigan was, however, rapidly withdrawn towards Pir Paimal, and the forward movement of the two brigades continued after the capture of the first village almost without a pause. The position of the 3rd Brigade at this time was designed as a support to this advance, as also to meet any counterstroke which Ayub Khan might attempt from the Baba Wali Pass against the troops under command of Brigadier-General Burrows. The main body of the Afghan regular troops was known to be immediately behind the pass, and until the shoulder of the hill had been reached by our advance, and the attack on Pir Paimal itself was fully developed, the 3rd Brigade was not moved. The cavalry[1] on the left were, however, at once relieved, and scouting, as far as Kokeran, advanced rapidly to execute the extended movement entrusted to them.

Turning the shoulder of the hill (a very precipitous one) above Pir Paimal, the 1st Brigade came under a heavy fire, and a stout resistance was offered in the village itself; our troops, the 92nd and 2nd Goorkahs still leading, were not, however, to be deterred, and the village was gained at 12.15 P.M., the 2nd Brigade being, at this time, clear of the village, and so far advanced as to be obliged to delay until Pir Paimal was carried.

Covering the main camp at Mazra, there still remained a strong

29th Bombay Native Infantry (2nd Biluchis).
(Khelat-i-Ghilzai Garrison).
No. 2 Mountain Battery (attached).

3rd Brigade (Infantry), Brigadier-General MacGregor, C.B., C.S.I., C.I.E. Commanding.

2 | 60th Rifles.
4th Goorkahs.
15th Sikhs.
25th Punjab Native Infantry.
11 | 9 Royal Artillery (attached).

[1] *Cavalry Brigade.*

Brigadier-General Hugh Gough, C.B., V.C., Commanding.

9th Lancers.
3rd Bengal Cavalry.
3rd Punjab Cavalry.
Central India Horse.

position to the enemy, and behind this several field guns were placed; to this the two brigades moved forward without interruption, fighting their way; the final charge, made by the 92nd Highlanders, the 2nd Goorkahs, and the 23rd Pioneers, resulted in the capture of the guns and the precipitate flight of the enemy.

Ayub Khan must have realized some time previous that the day was lost to him. His regular troops made off through the thick gardens and orchards of the Argandab, the Herat regiments towards Zamindawar and Herat, and the Kabul regiments by the Argandab valley towards Ghazni.

By 1 o'clock our troops were in possession of Ayub Khan's camp and all his ordnance.

During the last stage of the advance our signallers with the leading brigade moved to the Baba Wali Pass, just abandoned by the enemy, for the purpose of signalling the result of the attack to Lieutenant-General Primrose's headquarters, now stationed on Picket Hill, Sir Frederick Roberts having advanced with the 3rd Brigade in support of the main attack. Captain Straton, the Superintendent of Army Signalling, pressing forward in eager haste in advance of the party, was here shot by an Afghan who had concealed himself behind some rocks.

An order had already been despatched for the cavalry on the right to move over the Baba Wali Pass and pursue the retiring enemy by the direct road leading through the Argandab Valley, and very shortly after Sir Frederick Roberts reached Mazra, the 3rd Scinde Horse and 3rd Bombay Light Cavalry, under Brigadier-General Nuttall, were advanced in pursuit.

On the night of the 1st September, the 1st Infantry Brigade encamped at Mazra, the remainder of the troops returning to their encampments near the cantonments. Our cavalry reached camp between 8 and 9 P.M., after inflicting a loss of some 300 upon the fugitive enemy.

Just as it is difficult to understand the rapidity with which large numbers are assembled in Afghanistan for fighting purposes, so the dispersing of an Afghan Army and its attendant masses of tribal levies in flight is almost beyond comprehension; men who have been actually engaged in hand-to-hand combat dispose of their arms in the villages they pass through, and meet their pursuers with melons or other fruit in their hands, while they adopt the *rôle* of peaceful inhabitants.

Of the thousands serving with pride under Ayub Khan's orders on the morning of the 1st September, but a few horsemen and a small party of Herat infantry accompanied him in his flight; the rest were not!

By estimates subsequently made, the strength of the Afghans in position on the 1st September has been fixed at—regular infantry, 4,000; cavalry, 800; Ghazis, 5,000; irregular cavalry, 3,000. When the attack was made it was, however, almost impossible to come to any conclusion regarding their numbers, while it was equally impossible to measure the loss inflicted on them; the battle of Kandahar is,

at the same time, one of the rare instances in which a Mahomedan army has been so completely routed as to make but small effort to carry off its dead. From 700 to 800 bodies were buried by us during the three days immediately following, and every possible opportunity for removal was given to the Afghans. The British loss, as given in returns, amounted to 40 killed and 228 wounded.

The DUKE OF CONNAUGHT: As no Officer wishes to offer any remarks, it only devolves upon me to express to Colonel Chapman the thanks of everyone present for the admirable paper to which we have just listened. I hope I may be allowed to endorse the remarks of Colonel Chapman as to how much we regret the absence of Major-General Sir Frederick Roberts. All that we have heard has proved how admirable were the arrangements made by that distinguished Officer. We have heard a full description of his march from the time when he first received orders to the time after the Battle of Kandahar. We have seen how thoroughly he understood what the components of an army must be for an operation of this kind, and how he entrusted to the different Officers their several positions and responsibilities. Gentlemen, it would be very venturesome on my part, and it would not be in good taste, if I were to make any remarks on the subject. I only wish to say how very much gratified we have been at the very full and able manner in which Colonel Chapman has placed everything before us. As far as it is possible we, who were not present and have only been able to follow the accounts given in the newspapers from day to day, have now been placed in possession of full information on this most important subject. In your name, then, I beg to thank Colonel Chapman most heartily for his most interesting lecture on the important march terminating in the Battle of Kandahar.

APPENDIX.

NORTHERN AFGHANISTAN FIELD FORCE,

Under the Command of Lieutenant-General Sir D. M. Stewart, K.C.B.

1st August, 1880.

1st and 2nd Divisions, Headquarters, Kabul.

Lieutenant-General Sir F. S. Roberts, K.C.B., C.I.E., V.C., Commanding.

Abstract.

British troops.	Officers.	Non-commissioned officers and men.			Percentage of sick during month.	Deaths during month.	Horses.	Guns.
		Present.	Absent.	Total.				
Staff, &c.	40							
Royal Artillery	20	414	43	457	4·83	1	[1]354	16
British Cavalry	21	344	17	361	5·52	..	384	
„ Infantry	80	2,655	316	2,971	5·38	5		
Total	161	3,413	376	3,789	..	6	738	16

[1] 218 mules.

Abstract.

Native troops.	British Officers.	Native commissioned, non-commissioned officers and men.			Percentage of sick during month.	Deaths during month.	Horses.	Guns.
		Present.	Absent.	Total.				
Artillery	9	368	95	463	3·80	1	[1]251	12
Sappers and Miners	11	432	..	432	..	8		
Cavalry	28	1,326	316	1,642	3·39	4	1,654	
Infantry	95	6,643	897	7,540	2·87	25		
Total	143	8,769	1,308	10,077	..	38	1,905	12

[1] 243 mules.

NORTHERN AFGHANISTAN FIELD FORCE,

Under the Command of Lieutenant-General Sir D. M. Stewart, K.C.B.

1*st August*, 1880.

3rd Division, Headquarters, Camp Indiki.
Major-General J. Hills, C.B., V.C., Commanding.

Abstract.

British troops.	Officers.	Non-commissioned officers and men.			Percentage of sick.	Deaths.	Horses.	Guns.
		Present.	Absent.	Total.				
Staff, &c.	8							
Royal Artillery	19	376	33	409	3·18	1	[1]527	18
British Cavalry.								
„ Infantry	45	1,267	202	1,469	1·97	2		
Total	72	1,643	235	1,878	..	3	527	18

[1] 198 mules.

Abstract.

Native troops.	British Officers.	Native commissioned, non-commissioned officers and men.			Percentage of sick during month.	Deaths during month.	Horses.	Guns.
		Present.	Absent.	Total.				
Artillery.								
Sappers and Miners	5	197	..	197	2·42	1		
Cavalry	21	742	114	856	5·96	3	890	
Infantry	30	2,630	27	2,657	..	2		
Total	56	3,569	141	3,710	..	6	890	

NORTHERN AFGHANISTAN FIELD FORCE.

Under Command of Lieutenant-General Sir D. M. Stewart, K.C.B.

1st August, 1880.

Khyber Line Force, Headquarters, Safed Sang.
Major-General R. O. Bright, C.B., Commanding.

Abstract.

British troops.	Officers.	Non-commissioned officers and men.			Percentage of sick during month.	Deaths during month.	Horses.	Guns.
		Present.	Absent.	Total.				
Staff, &c.	90							
Royal Artillery	14	371	54	425	7·27	7	[1]502	18
Cavalry	24	381	7	388	20·73	3	344	
Infantry	107	3,749	394	4,143	13·65	27	..	
Total	235	4,501	455	4,956	..	37	846	18

[1] 244 mules.

Abstract.

Native troops.	British Officers.	Native commissioned, non-commissioned officers and men.			Percentage of sick during month.	Deaths during month.	Horses.	Guns.
		Present.	Absent.	Total.				
Artillery	5	133	94	227	3·75	1	115	6
Sappers and Miners	11	430	17	447	15·34			
Cavalry	32	1,619	147	1,766	1·54	3	1,781	
Infantry	95	7,862	788	8,650	4·48	30		
Total	143	10,044	1,046	11,090	..	34	1,896	6

[1] 111 mules.

KURAM FORCE.

1*st August*, 1880.

Headquarters, Peiwar Kotal.

Major-General J. Watson, C.B., V.C., Commanding.

Abstract.

British troops.	Officers.	Non-commissioned officers and men.			Percentage of sick during month.	Deaths during month.	Horses.	Guns.
		Present.	Absent.	Total.				
Staff, &c.	28							
Royal Artillery	13	297	7	304	7·73	..	[1]529	14
Cavalry.								
Infantry	48	1,658	75	1,733	6·15	4		
Total	89	1,955	82	2,037	..	4	529	14

[1] 57 mules.

Abstract.

Native troops.	British Officers.	Native commissioned, non-commissioned officers and men.			Percentage of sick during month.	Deaths during month.	Horses.	Guns.
		Present.	Absent.	Total.				
Artillery.								
Sappers and Miners	2	110	..	110				
Cavalry	16	935	58	993	8·33	4	986	
Infantry	45	3,548	197	3,745	8·31	19		
Total	63	4,593	255	4,848	..	23	986	

KANDAHAR FORCE.

Compiled from latest Returns received.

(Taken from Return of the Distribution of the Army in the Bombay Presidency, dated 1st August, 1880.)

Headquarters, Kandahar.

Lieutenant-General J. M. Primrose, C.S.I., Commanding.

Abstract.

British troops.	Officers.	Non-commissioned officers and men.			Percentage of sick during month.	Deaths during month.	Horses.	Guns.
		Present.	Absent.	Total.				
Staff, &c.	19							
Royal Artillery	25	469	18	487	9·68	4	325	18
British Cavalry.								
„ Infantry	69	2,239	39	2,278	3·83	3		
Total	113	2,708	57	2,765	..	7	325	18

Abstract.

Native troops.	British Officers.	Native commissioned, non-commissioned officers and men.			Percentage of sick during month.	Deaths during month.	Horses.	Guns.
		Present.	Absent.	Total.				
Artillery	2	174	3	177	1·72	..	..	6
Sappers and Miners	10	368	..	368		1		
Cavalry	46	2,591	84	2,675	3·82	4	2,839	
Infantry	93	8,460	503	8,963	3·77	23		
Total	151	11,593	590	12,193	..	28	2,839	6

Detailed Return of the Force under Command of Lieutenant-General Sir F. Roberts, K.C.B., V.C., C.I.E., dated 25th August, 1880.

Corps, &c.	European.				Native Officers, non-commissioned officers and men.	Followers.		Horses.	Battery mules.	Riding camels.	Medical.		Transport.				Grass cutters' ponies.	Bullocks.	Camels.
	Officers.	Chaplains.	Non-com. officers and men.	Total.		Public.	Private.				Medical subordinates.	Hospital establishments.	Yaboos.	Mules.	Indian Ponies.	Donkeys.			
Kabul Kandahar Field Force :—																			
Headquarters Staff	23	2	41	66	89	142	117	108	..	..	..	..	..	164					
Cavalry Brigade Staff	8	..	..	8	..	11	32	21	..	..	..	..	..	15					
Cavalry Brigade	45	..	313	358	1,283	1,313	541	1,686	..	20	9	314	..	861		..	910		
Infantry Divisional Headqr. Staff	9	..	..	9	..	12	37	22	..	..	..	..	9	10	1				
1st Infantry Brigade	53	..	773	826	1,919	1,392	157	60	218	..	..	..	398	895	439	43	..	5	6
2nd Infantry Brigade	62	..	711	773	2,001	2,027	196	82	171	..	..	..	486	2,003	347	51			
3rd Infantry Brigade	64	..	717	781	2,033	1,679	164	80	184	..	..	..	607	1,264	..	537			
Press	1	..	..	1															
Postmaster	..	..	1	1															
Kabul-Kandahar Field Force	265	2	2,556	2,823	7,325	6,576	1,244	2,059	573	20	9	314							
Khelat-i-Ghilzai Garrison	15	..	193	208	758														
	280	2	2,749	3,031	8,083														

Hospital establishments of infantry brigades shown with "public followers."

Return of Bearers and Sick Carriage with the Kabul-Kandahar Field Force. Dated 16th August, 1880.

Corps.		Bearers.	Doolies.	Dandies.	Ponies.	
Cavalry Brigade.	9th Lancers	134	6	21	6	
	Central India Horse	86	5	8	11	
	3rd Bengal Cavalry	72	2	14	6	
	3rd Punjab Cavalry	90	3	16	26	
1st Inf. Brigade.	6 | 8 Royal Artillery	67	2	10	6	
	92nd Highlanders	214	14	28	21	
	2nd Goorkahs	86	5	11	13	23 donkeys.
	23rd Punjab Native Infantry (Pioneers).	107	6	15	32	
	24th Punjab Native Infantry	113	3	21	17	
2nd Inf. Brigade.	No. 2 Mountain Battery	51	4	7	12	
	72nd Highlanders	220	16	24	16	
	2nd Sikhs	110	5	18	15	
	3rd Sikhs	86	3	16	19	
	5th Goorkahs	80	3	13	20	
3rd Inf. Brigade.	11 | 9 Royal Artillery	38	2	11		
	2 | 60 Rifles	132	14	19	28	
	4th Goorkahs	232	11	33		
	15th Sikhs	108	3	16	19	
	25th Punjab Native Infantry	106	6	16	19	
Field Hospital.	Section B	6	1	2	..	20 donkeys.
	Section A	54	1	2		3 bullocks.
	Section F					6 camels.
		2,192	115	321	286	43 donkeys. 3 bullocks. 6 camels.

Return of Transport Animals employed with the Kabul-Kandahar Field Force. Dated 7th September, 1880.

	Yaboos or Afghan ponies.	Mules.	Indian ponies.	Donkeys.	Camels.
Number of animals that left Kabul on the 8th August	1,589	4,510	1,244	912	6[1]
Purchased en route	35	1	..	208	171
Number of such animals that arrived at Kandahar 31st August	1,179	4,293	1,138	1,078	177
Casualties	445	218	106	42	

[1] With hospital equipment.

Owing to the rapidity of the march, sore backs were very numerous.

Present State of the Garrison at Khelat-i-Ghilzai. Dated 22nd August, 1880.

Corps.	European Officers.	European non-commissioned officers and men.	Native Officers.	Native non-commissioned officers and men.	Total.
C | 2 Royal Artillery	1	48	..	..	49
3rd Scinde Horse	1	..	3	100	104
66th Regiment	5	145	..	..	150
2nd Biluch Regiment (29th Bombay Native Infantry)	8	..	16	639	663

Present State of the Kandahar Garrison. Dated 1st September, 1880.

Corps.	Effective.			Sick.			Guns.	Horses.	Bullocks.
	European Officers.	Native Officers.	Non-commissioned officers and men.	European Officers.	Native Officers.	Non-commissioned officers and men.			
Staff	18								
E | B Royal Horse Artillery.	6	..	129	..	..	..	4	123	18
C | 2 Royal Artillery	5	..	135	..	..	26	6	122	29
5 | 11 Royal Artillery	3	..	92	..	..	3	4	5	71
Poona Horse	5	9	160	..	..	12	..	182	
3rd Scinde Horse	4	12	430	2	1	20	..	481	
3rd Bombay Light Cavalry	5	11	325	1	4	36	..	342	
2 | 7th Royal Fusiliers	15	..	518	6	..	114			
66th Regiment	13	..	376	2	..	73			
1st Bombay Grenadiers	3	4	304	3	4	33			
4th Bombay N. I.	4	16	467	2	..	34			
19th Bombay N. I.	6	11	497	..	1	35			
28th Bombay N. I.	4	16	551	1	..	50			
30th Bombay N. I.	4	8	332	1	2	54			
No. 2 Co. Sappers and Miners.	1	..	38	..	2	18			
	96	87	4,354	18	14	508	14	1,255	118

KABUL TO KANDAHAR.

Stages marched by Sir F. Roberts' Force in August, 1880, *with the corresponding Stages made by Sir D. Stewart's Force in April*, 1880.

FOR purposes of comparison, Haiderkhe, on the Kabul-Ghazni road, may be considered as the first stage common to both marches.

Haiderkhel, *viâ* the Logar Valley, is 58 miles from the camps of Sir F. Roberts, near Kabul, on the August, 1880.

Sir F. Roberts' March.	Miles.	*Sir D. Stewart's March (reversed).*	Miles
1. Haiderkhel to Shashgao ..	16	1. Haiderkehl to Haft Asia ..	10½
		2. Haft Asia to Shashgao ..	9¼
2. Shashgao to Ghazni	15	3. Shashgao to Ghazni	13¼
		4. Ghazni to Ispandi	7
3. Ghazni to Yarghalta	20	5. Ispandi to Nani	7
		6. Nani to Mushaki	19
4. Yarghalta to Chardeh ..	13	7. Mushaki to Jamrud ..	9
5. Chardeh to Karez-i-Oba ..	16	8. Jamrud to Oba	14
6. Karez-i-Oba to Mukur ..	14	9. Oba to Mukur	14
		10. Mukur to Ghojan	11½
7. Mukur to Kila-i-Tuman ..	21	11. Ghojan to Chashma-i-Panjak	11
8. Kila-i-Tuman to Gajai ..	18	12. Chashma-i-Panjak to Shahjui	8
		13. Shahjui to Tazi	12
9. Gajai to Baba Kazai	17½	14. Tazi to Naorat	7
		15. Naorat to Sir-i-Asp	12
10. Baba Kazai to Khelat-i-Ghilzai	16½	16. Sir-i-Asp to Khelat-i-Ghilzai	10
		17. Khelat-i-Ghilzai to Pul-i-Sang	7
11. Khelat-i-Ghilzai to Jaldak ..	15¾	18. Pul-i-Sang to Jaldak ..	8¾
12. Jaldak to Tirandaz	16	19. Jaldak to Tirandaz	14
		20. Tirandaz to Shahr-i-Saffa ..	10
13. Tirandaz to Pomazai	15	21. Shahr-i-Saffa to Khel-i-Akhund..	12
14. Pomazai to Robat	19	22. Khel-i-Akhund to Robat ..	12
15. Robat to Mohmand	7½	23. Robat to Mohmand	8
16. Mohmand to Kandahar ..	13	24. Mohmand to Kandahar ..	12

It will be seen from the above that the total distances are given at slightly different figures in the respective official accounts of the two marches. The apparent discrepancies in the recorded lengths of identical stages are easily accounted for on the assumption that the actual camping-grounds were not identical, although probably named after the principal town or village in their neighbourhood.

This comparison is not made for the purpose of detracting in any way from Sir D. Stewart's march of April, 1880, but simply to indicate the difference between the stages made on a forced march, and those covered on an ordinary occasion where there is no great urgency.

Friday, February 11, 1881.

VICE-ADMIRAL G. G. RANDOLPH, C.B., in the Chair.

STUDY OF THE TACTICS OF NAVAL BLOCKADE AS AFFECTED BY MODERN WEAPONS.

By Captain SAMUEL LONG, R.N.

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I. THE blockade of an enemy's coasts, including his arsenals and commercial ports, is one of the most common, one of the most important, and we may add one of the most trying and monotonous of naval duties in war. And if this be true with respect to all nations, it is doubly so with respect to this country, to whom blockade by sea would be ruin, and whose commerce would suffer most seriously, should she at any time be unable to confine the majority of her enemy's war ships and privateers to their own ports.

We need but glance back at the history of the last hundred years to find ample support for these assertions. During the war waged against France from 1793 to 1802, and 1803 to 1814, we find the British Government alarmed[1] in 1801 by their experience that, notwithstanding the greatest maritime superiority, it was impossible at all times to

[1] Alison's "History of Europe," vol. iv, p. 604.

prevent a vigilant and active enemy from putting to sea during the darkness of autumnal or winter months.

Again, in 1805, when the Rochfort squadron paid a flying visit to the West Indies, the same historian tells us[1]: "The successful issue of "this expedition excited the greatest alarm in Great Britain, from the "evidence which it afforded of the facility with which, notwithstanding "the utmost vigilance of the blockading squadrons, the enemy's fleet "might leave and regain their harbours, and carry terror into her most "distant colonial possessions." On April 25th, 1814, the British Government[2] declared the ports of the United States north and south of New York in a state of blockade, and the United States Government issued a counter-proclamation stating that a blockade of 2,000 miles of coast line could not be enforced, and was an unwarrantable stretch of belligerent rights. As a commentary on this, the statement of the Secretary of the United States Navy in 1865 is interesting. He says[3]: "During "the war of 1812, our navy of 301 vessels made but 291 captures. "There were 517 commissioned privateers, and their captures numbered "1,428."

Passing on to 1854, we find[4] the first head of the orders issued to Sir Charles Napier was to "keep the Russian fleet shut up in the "Baltic and prevent their cruisers slipping out to the injury of our "commerce and coasts."

In the war of 1861-65 between the Northern and Southern States of America, the first step taken by the Federal Government was to appoint a Commission to report on the best manner of effectively blockading the southern ports and coasts, and the work of the navy at sea during the war lay principally in carrying this intention into effect. The later wars in Europe have been fought out principally on land, and, excepting the naval campaign of Lissa in 1866, and the obstruction the Russian armies suffered during the late war, from the Turks having the command of the Black Sea, there have been no very striking instances of the importance of naval blockade.

The foregoing, however, may be sufficient to indicate the importance to the profession of sound views on blockading operations.

II. Naval warfare falls conveniently under three heads—open sea, coast, and river. Our present subject lies principally within the province of the second, and it may be as well to define its limits, which I conceive include all operations indispensably subsidiary to blockade, and therefore may involve the reduction of small outlying forts, but exclude any operations having for their object the attack of a regular maritime fortress.

Blockade by sea may be conveniently divided into—

(*a.*) That instituted against an important arsenal, the head-quarters of a powerful fleet, with a view to prevent the issue of hostile expeditions. The proceedings of the Baltic and Black Sea fleets in 1854-55 furnish an example of this, rendered, how-

[1] Alison's "History of Europe," vol. v, p. 320.
[2] *Ibid.*, vol. x, p. 719.
[3] Report of Secretary of United States Navy," 1865, p. 29.
[4] "The Baltic Campaign of 1854." G. B. Earp, from Sir C. Napier's papers.

ever, very imperfect by reason of the inferior type of the Russian ships, consequent on the recent introduction of steam.

(*b.*) That instituted against fortified commercial ports to stop commerce with the enemy and prevent the issue of privateers or war ships.

The proceedings of the Federal Navy on the coast of North America during the war of 1861–65 furnish the most conspicuous example of this kind.

The principles governing all warlike operations must here be noticed. Strategy, from the Greek word for Commander-in-Chief, may perhaps be defined the science proper to Commanders-in-Chief. General Hamley says[1]: "The theatre of war is the province of strategy, the "field of battle that of tactics." The purely military advantages to be obtained by strategical operations are of two kinds—1. The probabilities of victory; 2. The consequences of victory.

No operation can be without risk to both sides, and none, says Sir Howard Douglas,[2] should be undertaken without weighing carefully both the successful and the unsuccessful issue.

Good strategy consists in so using your forces that defeat shall involve but small and unimportant losses, while victory involves large and important gains. Good tactics generally involve overwhelming a portion of the enemy's force with the whole or a greatly superior portion of your own. The operations open to a Naval Power desirous of blockading an enemy's coast will obviously depend materially on the amount and disposition of the naval force of that enemy. Should it be small and easily imprisoned, and should the fear of other political complications be absent, risks of the fleet may be admissible, which under other circumstances would never be contemplated. As an example of the former conditions, the bombardment of Sevastopol by the allied fleets on October 17, 1854, after the self-destruction of the Russian fleet, may be cited.

The fate of the Italian fleet at Lissa[3] is a striking instance of the consequence of disregarding strategical principles in face of an enterprising enemy. Under the influence of an ignorant but enthusiastic public opinion, Admiral Persano was ordered to attack Lissa, situated 120′ south-east of Ancona, with forts and batteries mounting nearly 100 guns, and garrisoned by from 2,000 to 2,500 men, the island being in telegraphic communication *viâ* Lesina with Pola, 150′ to the north-west, where lay the Austrian fleet under Tegethof. Admiral Persano, against his judgment, left Ancona on July 16th, 1866, with his fleet of five formidable wholly ironclad ships, mounting 114 heavy guns, seven partially ironclad vessels, with 134 guns, and 18 unplated vessels, with 366 guns, in all 33 ships, 614 guns, and 9,727 men, besides a landing party of 1,200 more. He bombarded the forts on the 18th and 19th, and attempted to land his troops, and was on the point of renewing

[1] "The Operations of War explained and illustrated," 1878. "Naval Gunnery."

[3] "Revue des Deux Mondes," November 15th, 1866. "Lessons from Lissa," Capt. P. H. Colomb, vol. ix, No. XLIII, Journal R. U. S. I.

his operations on the 20th July, when the Austrian fleet, under Admiral Tegethof, consisting of seven ironplated ships, with 176 guns, and 19 other vessels of various sizes, mounting 355 guns,—in all 27 ships, 531 guns, and 7,906 men, hove in sight. The Italian Admiral had to engage with tired crews, 16 men killed and 95 wounded, several of his ironclads damaged, one of the most powerful, the "Formidabile," *hors de combat* (from her engagement at 320 yards distance singly with the Madonna casemated battery at Port St. Georgio, where she was hulled ninety times), his shell-rooms and magazines partially empty (the "Ré d' Italia" fired on 18th 1,300 projectiles, or 72 rounds per gun, one broadside) his wooden ships and gunboats ill prepared to join in the battle, and the rest of his ironclads scattered over a length of eleven miles. Thus, in spite of the disparity of force (the "Affondatore" turret ram had been considered in England as a match singly for the whole Austrian fleet), the Austrians gained a decisive victory, which could hardly have been the case had the Italian fleet been unscathed.

III. I must now turn to the war of 1861–65 between the Federal and Confederate States of North America.

The portion of coast we are more especially to consider lies between Cape Lookout on the north, and Savannah on the south, and is about 60 miles distant from the inner edge of the Gulf Stream. The 20 fm. line lies from 25 to 40 miles off the shore, and the weather during the winter months is frequently stormy.

Fogs appear to occur occasionally, though in the Federal accounts they are not mentioned.

The objects[1] originally laid out for the Federal forces to achieve were:—

1. To blockade the sea coast of the Confederacy and prevent trade.
2. To open and keep command of the navigation of the western rivers.
3. To drive the Confederate Government from its chosen seat at Richmond.

This plan was known in the south as the "Anaconda plan," from its analogy to the manner in which that serpent secures its prey.

At the end of August, 1861, the Confederates held the coast from Alexandria on the Potomac, down that river to its mouth, and along the coast round to the entrances of the Mississippi, and also onwards to the Mexican frontier on the Rio Grande. The Secretary of the United States Navy in his Report for 1863, says: "The extent of coast "blockaded, according to an accurate table of measurement carefully "prepared at the Coast Survey Office, covers a distance of 3,549 statute "miles, with 189 harbours or river openings or indentations, and much "of the coast presents a double shore to be guarded."

The naval resources of the belligerents were very unequal. To begin with dockyards, the indispensable base of naval operations, the South possessed the remains of Norfolk which was burnt by the Federals on April 20th, 1861,[2] leaving the "Merrimac" only partially destroyed, and

[1] "Campaigns in Maryland and Virginia," Capt. Chesney, R.E., 1864.
[2] Boynton's "History of the U. S. Navy during the Rebellion," 1867.

Pensacola an unimportant yard without docks. The North possessed Philadelphia, Brooklyn, Boston, and Portsmouth.[1]

Mr. Donald McKay, an eminent ship-builder, says: "Our ship-building power has not in the least suffered by the loss of the seceded States, "they did not build 1 per cent. of the ships built in the Union." As to ships of war, the South possessed only the broken hull of the "Merrimac," while the North had 42 steam-vessels, carrying 555 guns and 7,600 men; but of these only four were in Northern ports and available for service at the outbreak of the conflict.

To understand the position of affairs when the blockade of Charleston and Cape Fear River (Plate VIII) were fairly entered on, we must glance at the naval operations preliminary to maintaining those blockades. Immediately after closing the ports of the States in rebellion and giving that act the character of a blockade, the efforts of the Navy Department were directed towards securing several harbours at comparatively equidistant points, as bases of operations for the several squadrons, into which they could conveniently enter for repairs, refit, and supplies, instead of returning to the Northern ports for that purpose; which would have endangered the efficiency, and in some instances might even have involved the abandonment of the blockade. The first operation was the capture of the forts at Hatteras Inlet, of which a detailed account was given here by Rear-Admiral V. Hamilton, R.N., in May, 1878. This took place on August 29th, 1861, and was followed by the capture of Ocracoke Inlet on September 17th, and of Roanoke Island, February 8th, 1862.

The capture of Newbern,[2] March 14th, 1862, and of Fort Macon, by which the important harbour of Beaufort, N.C., fell into Federal hands, completed by April 25th, 1862, the naval command of the North over Pamlico Sound and adjacent inlets.

Beaufort Harbour,[3] henceforward the head-quarters and base of the squadron blockading Cape Fear River (is 83′ N. of Cape Fear), has shelter from all winds, and is easy of access: 17 feet may be carried over the bar at mean low water.

A naval station south of Hatteras being needed for repairing iron-clads, and replenishing the ships with stores and provisions, that of Port Royal in Georgia, 55 miles south of Charleston, was fixed upon. The deepest channel carries 21 feet at low water,[4] with a rise of 3 feet at spring tides, its capture[5] is detailed in Rear-Admiral Hamilton's paper before referred to, and took place on November 7th, 1861, after which it became the head-quarters and base of operations of the Federal South Atlantic squadron, charged with the blockade of 300 miles of coast, a considerable portion of which is a network of inlets and sounds, and which includes the cities of Charleston and Savannah.

I will now pass on to Charleston Harbour. If an observer were

[1] "War Ships and Navies of the World," King, 1880.
[2] Boynton's "History of the U. S. Navy during the Rebellion."
[3] "Sailing Directions for the principal ports in the United States."
[4] *Ibid.*
[5] It is stated by Pollard, "that the smoke drifting on Fort Walker greatly "baffled the gunners."

Fig 1

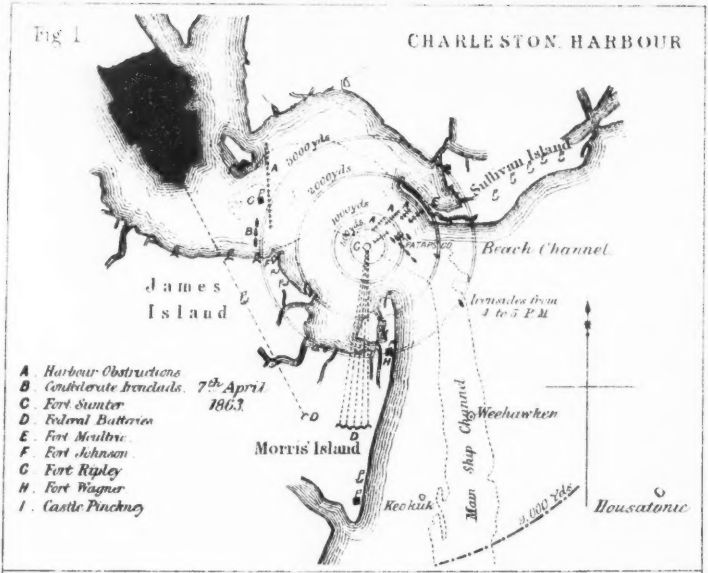
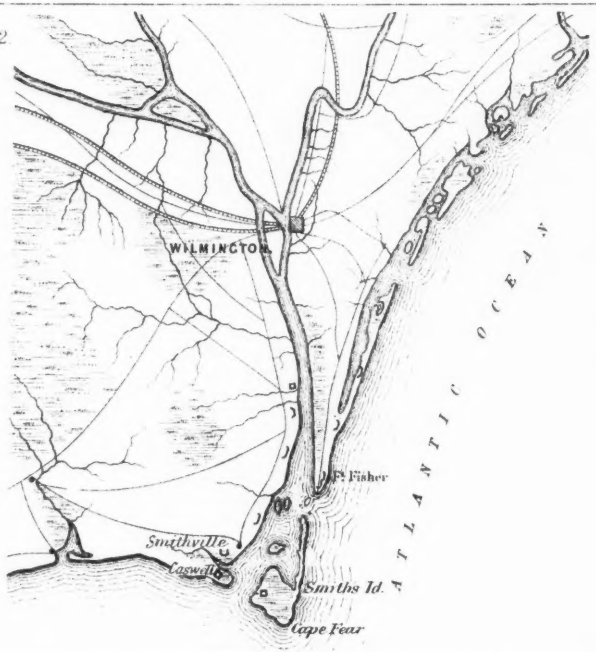

CHARLESTON HARBOUR
Sullivan Island
Beach Channel
James Island
Morris Island
Weehawken
Main Ship Channel
Housatonic
Keokuk
A Harbour Obstructions
B Confederate Ironclads
C Fort Sumter
D Federal Batteries
E Fort Moultrie
F Fort Johnson
G Fort Ripley
H Fort Wagner
I Castle Pinckney
7th April 1863

Fig 2


WILMINGTON
Ft Fisher
Smithville
Caswell
Smiths Id.
Cape Fear
ATLANTIC OCEAN

anchored in the centre of the channel between Fort Moultrie and Cumming's Point, he would, looking seaward, have a sea horizon of 115° from the shore of Sullivan's Island E. by N. ½ N. to that of Morris Island, S. ¾ W., and should the sea be rough, the whole of this arc would exhibit breakers, as the bar extends right across the entrance. Close to the shore of Sullivan's Island is Beach Channel, carrying 13 feet water. Next to this comes North Channel, with 10 feet; Swash Channel, 11 feet; and lastly, parallel to the shore of Morris Island, from which it lies on the average nearly a mile distant, is Main-ship Channel with 14 feet on the bar at L. W. S., the above depths being subject to an increase of 5 feet at neaps, and 6 feet at spring tides. As regards the batteries, a ship crossing the bar of the main channel would be 7,000 yards distant from Fort Wagner on Morris Island, and on turning up the channel 6,000 yards on reaching the buoy where the "Weehawken" sank, she would be 2,800 yards from Wagner, 5,600 from Fort Moultrie, 5,200 from Fort Sumter, and 5,300 from Fort Beauregard on Sullivan Island. When abreast Fort Wagner, she would be subject to the fire of some fifty heavy guns from 11 to 6 inch calibre at a range of about 3,000 yards. The harbour mouth is not the only sea route to Charleston. There is also communication between Ashley River and the sea south of Folly Island *viâ* Stono Inlet.

It is unnecessary to repeat the details of the obstructions and fixed torpedoes, both mechanical and electric, which formed part of the defences, and may be found described by Colonel von Scheliha, or in the report of the Secretary of United States Navy, 1865. After the capture of Charleston, Admiral Dahlgren reported that "quite sufficient "is certain to show that these several contrivances of obstructions and "torpedoes would have been as troublesome as it was expected they "would be, in connection with the heavy batteries that lined the "harbour and the enemy's ironclads."[1]

The general plan of blockade followed by the Federal commanders seems to have been that of dividing the available force into two squadrons, an inshore one, drawn as closely in as the state of the weather would permit, and an outer one, at a convenient distance outside; the inner ships were not allowed to chase off, but the outer ones were, and the larger vessels composed the outer line. The blockade during 1861 seems to have been very inefficient, and on December 20th, 1861, fifteen old whalers filled with stones were sunk on the bar of Main-ship Channel, without any effect in closing it, as the tide soon swept a passage. At the same time Mr. Pollard[2] states that the South had begun to feel severely the effects of the blockade and that their privateers were pretty closely confined within their own harbours and rivers by the blockading fleets. In April, 1862, the Federal Government issued a proclamation placing the coast under blockade, and the Secretary of the Navy reports, December, 1862: "Each "of our blockading squadrons, viz., the North Atlantic, South Atlantic, "East and West Gulf blockading squadrons has secured and holds a

[1] Two plated gunboats were captured at the surrender of Charleston.
[2] "The Lost Cause," A. E. Pollard.

"considerable portion of the coast within their respective limits, and in "each there is a commodious and open port for rendezvous, refitment, "and supply." At the commencement of the blockade, constant annoyance was experienced from various sources, by means of light draught vessels which emerged from and retreated into the sounds and inner waters of the coast. In October, 1862, a Torpedo Bureau was established at Richmond, and General Beauregard[1] assents to the opinion that, had the Confederate practice of submarine warfare been nearly as efficient at the commencement as it was at the close of the war, the blockade of the Southern ports would have been rendered so inefficient as to have commanded no respect from European Powers.

On February 2nd, 1863, when nine vessels, of which the "Housatonic" was the principal, and the others the light class of purchased ships, were on blockade, two ironclad gunboats came out of the harbour at 4 A.M. by the main ship-channel in a thick haze, and attacked and disabled the "Mercedita" and "Keystone State," but on the rest of the squadron approaching to their rescue, the Confederate vessels returned into port. The "New Ironsides," "Powhatan," and "Canandaigua" were sent to reinforce the squadron, but the success of the enterprise shows how an inferior force may act from the shelter of its forts. As these raids are a distinctive and purely naval feature of the war, I shall here cite that of the ram "Manasses"[1] against the squadron blockading the Mississippi on the night of October 12th, 1861; and again that of the ram "Albemarle" in Roanoke River in the spring of 1864. To return to the siege of Charleston: the Federal Government having reinforced Rear-Admiral Dupont with the "New Ironsides," 17, and 7 monitors, each carrying 2 guns, and the "Keokuk," an inferior vessel of monitor type, also of 2 guns, he was ordered to attack Charleston, and proceeded to do so on the afternoon of April 7th, 1863. The Confederate forts are stated to have had 76 guns bearing on the squadron, which had but 33 in all. The squadron moved in line ahead in close order, but on nearing the obstructions, the "Weehawken" leading, was obliged to turn, and some confusion seems to have occurred, the "New Ironsides," doubtless on account of her difference of tonnage, nearly three to one, and speed, getting out of station and having to anchor twice to avoid grounding. After being under fire from 2.50 P.M. to 4.30 P.M. as detailed by Mr. Hamilton,[2] C.S., in his paper read here June 1st, 1868, the squadron withdrew. Of this attack I shall only remark, that it was based on an exaggerated idea of the powers of the monitors, and that their defensive advantages alone saved the whole fleet from the fate of the "Keokuk," which sank at her anchors the following morning. The Federal Government ordered the fleet to continue within the bar, and relieved Admiral Dupont by Admiral Dahlgren, at the same time ordering General Gilmore, with a force of 11,000 men, to capture Morris Island and destroy Fort Sumter. Morris Island is a low irregular mass of white quartz sand accumulated on the marsh land. At its south end are some sand hills about 36 feet high, and at Fort

[1] Col. Fletcher's "History of the War."

[2] Journal R. U. S. Institution, 1868, vol. xii, No. XLIX.

Wagner it has a width of only 25 yards and the neck is sometimes submerged. Fort Wagner was a sand work with bombproofs for 1,500 men mounting 18 guns, and at battery Gregg, on Cumming's Point, were seven more. Only a précis of the events of the siege, in many respects a remarkable one, can here be given, but full details can be found in General Gilmore's work. In less than a month he made batteries on Folly Island screened by the woods, mounting 48 guns and mortars, opened fire upon, and captured the defences at the south end of Morris Island on July 10th; assaulted Fort Wagner and was repulsed on the 11th; placed 25 rifled guns and mortars in position at 1,350 yards from Wagner by the 17th; silenced its fire and assaulted it on July 18th, and was repulsed with a loss of 1,517 killed and wounded; finally he constructed batteries to disable Fort Sumter, especially its upper barbette guns, whose fire (47 feet above the water) was especially dreaded by the ironclads. One 300-pr. 6 200-prs. and 9 100-pr. rifled guns, with others, were mounted at distances from Fort Sumter of 3,200 and 4,235 yards, and it was destroyed for offensive purposes over the heads of the other batteries by September 1st. On September 4th a heavy fire was opened upon Fort Wagner, which was evacuated after forty-two hours bombardment, and the whole of Morris Island occupied by the Federals on September 6th.

The "New Ironsides" assisted greatly in this last bombardment, during the day time, keeping up a regular, precise, and almost incessant stream of 11-inch shells ricocheting over the water against the sloping parapet of Wagner, whence deflected upwards with low remaining velocity they dropped nearly vertically, exploding within or over the work and vigorously searching every part of it except the subterranean shelters. On shore the calcium lights turned night into day, and while throwing around the Federal men an impenetrable obscurity, they brilliantly illuminated every object in front and brought the minutest details of the fort into sharp relief. General Gilmore remarks that the bombproof shelter remained practically intact, and states that 1 lb. of metal was thrown for every $3\frac{1}{4}$ lbs. of sand moved owing to the flatness of the slopes, and that the place could never have been reduced by a naval force. On the night of September 7th-8th, Fort Sumter was unsuccessfully assaulted by a strong landing party from the fleet, the army having also organized another, which did not come off as the naval one was expected to be successful.

After the capture of Morris Island, the monitors lay inside the bar, and at night two moved up to the entrance of the harbour, the outside squadron remaining on blockade off the northern channels. On October 5th, Lieutenant Glassell, C.S., attempted to blow up "New "Ironsides" with a spar torpedo but failed. On November 17th a heavy fire was opened by the Confederates on Cumming's Point, and the monitors moved up to prevent any attempt at recapture. The "Lehigh" grounded and the "Nahant" towed her off in daylight under cover of the fire of the other monitors. General Gilmore says: "An attempt to "illuminate the waters near Cumming's Point with the calcium lights "was only partially successful, as the distance, over 3,000 yards, was too

" great for the apparatus which we had. The idea was to throw a cone " of light upon the water approach and station the guard-boats in the " obscurity just outside the lateral limits of the cone. The plan I am " convinced was entirely practicable with powerful reflectors."

On December 6th, the "Weehawken" sank at her anchors, the supposed reason being the separation of the hull and overhang. On February 17th, 1864, the "Housatonic" was destroyed by Lieutenant Dixon, C.S., with a spar torpedo, himself and crew perishing.

Admiral Dahlgren writes: "As a probable consequence, the whole line " of our blockade will be infested by these cheap, convenient, and formid- " able defences, and we must guard every point." . . . . . "I believe " torpedoes to constitute the most formidable of the difficulties in the " way to Charleston." However, we only find two other boat attacks on vessels of the Admiral's squadron, one on the "Memphis" in North Ediston River, and the other on the "Wabash," off Charleston, both of which failed. General Beauregard had formed the same estimate as regards the value of this kind of defence, but had not the means of putting the system into execution, and, moreover, great precautions were henceforward taken on both sides against such attacks. Admiral Dahlgren's orders were:—

"If vessels on blockade are at anchor they are not safe, particularly " in smooth water, without outriggers and hawsers stretched round and " rope netting dropped in the water. Vessels on inside blockade had " better take post outside at night and keep under way until these pre- " cautions are completed. All the boats must be on patrol when the " vessel is not in movement. The commanders of vessels are required to " use the utmost vigilance, nothing less will serve."

On January 16th, 1865, the "Patapsco," while on picket duty at the entrance, struck a submerged mechanical torpedo which had been laid down with 70 lbs. powder the night before, and sank, 62 officers and men being drowned. On reporting this, Rear-Admiral Dahlgren remarks: "The 'Patapsco' had her torpedo fenders and netting stretched " round her as usual, and three boats with drags had preceded her " searching to some depth the water they had passed over. Nothing " more can be done to bar the chance of accident, save the fitting of " permanent torpedo-catchers, substantially made and attached to the " bows so as to be entirely submerged and thus not exposed to shot in " action. This cannot be done here. No one who has not witnessed it " can appreciate the harassing nature of the never ceasing vigilance " with which the monitor duty is maintained in this harbour, no matter " what the weather may be, amid the heat of summer, the cold of winter, " or the heavy gales and bad weather which so often visit this anchor- " age." In February, 1864, the Admiral had asked for more vessels on the outer blockade, saying: "The great wear and tear of the heavy " weather of the season always keeps an inconvenient number off duty."

I must now conclude my notice of the principal events of the Charleston blockade. At the end of 1864 the Secretary of the Navy reports that after the withdrawal of the troops from the neighbourhood in May, 1864, the presence of the ironclads was indispensable to the continued possession of Morris Island, which, as well as the blockading

fleet, would have been assailed by the armoured vessels of the enemy. Rear-Admiral Dahlgren, in his report on the services of the monitors,[1] says: "The completeness with which four little monitors, supported by "an ironclad frigate, have closed this port is worth noting, . . . they "muster 8 guns and 320 men, which is almost insignificant in comparison "with the work done." After adverting to the delay incident to the distance whence labour and materials for repairs had to be procured, he remarks: "The bottoms were cleaned, having become so foul with "oysters and grass that the speed was reduced from 7 to 3 or $3\frac{1}{2}$ "knots, which, with the strong tide of this harbour, added considerably "to the difficulties of working the vessels properly under fire. One "night I was caught by heavy weather from south-east while close up "to Sumter, and it was well that the darkness of the night prevented "the slowness of our motion being perceived by the enemy."

He also remarks on the disadvantage of a ship possessing no end-on fire, which with the "New Ironsides" was particularly and frequently inconvenient in attacking the works on Morris Island, for at certain stages of the tide vessels tail nearly across the channel.

The report further states: "On this coast 10 or 11 feet is the most "convenient draught of water for penetrating all the principal sounds "and rivers and navigating them to any extent." The "New Ironsides" draught (16 feet) could not always pass the bar. The gallant Admiral had good reason to respect torpedoes, for on March 1st, 1865, his flag steamer "Harvest Moon" was blown up, at Georgetown, on ground which had been previously swept, and the ship sank immediately. The Admiral was waiting for his breakfast at the time, but as the explosion fortunately occurred under a large hatchway there was only one life lost.

With reference to the foregoing I remark:—

1st. That the monitors,[2] though admirably adapted for fighting in sheltered waters, were not equally suitable for sea work, and their weakest point is the small reserve of buoyancy, making subaqueous missiles their most formidable enemy.

2nd. That the small height of Fort Wagner above the water, and the lowness of the approaches, rendered it a most favourable object for the attack of vessels which could approach within 300 yards at high water, and take it in reverse without being nearer Forts Sumter and Moultrie than 2,300 yards. And as Admiral Dahlgren states that the monitors stood the enemy's shot well at 1,200 yards, it must be admitted to be a striking instance of the power of such works to resist mere cannonading.

3rd. Rope obstructions were found to be of value by the Confederates. General Beauregard remarks: "Shortly after these cables "were in position, a blockade runner attempting at night to "pass through the gap purposely left open near the Sullivan's "Island shore under the guns of Fort Moultrie, accidentally

[1] See Appendix I.
[2] Appendix II, Record of Firing.

"crossed the end of the rope obstruction, when one of the "streamers got entangled round the shaft, checking its "revolutions. The vessel was at once compelled to anchor to "avoid drifting on the torpedoes or ashore, and afterwards had "to be docked for the removal of the streamer before she could "again use her propeller."

4th. That no attempt was made by the Federals to diminish the space to be blockaded by adopting the tactics of their enemy and anchoring mechanical torpedoes across the three less important channels, inside the bar, which might probably have been easily done and would have been a more efficient stoppage than the outside squadron.

The Confederates laid down many more mechanical mines latterly, shortly before the destruction of the "Patapsco," and it appears[1] that it was owing to them, quite as much as to the presence of the monitors, that blockade running ceased at Charleston.

IV. Cape Fear River, on which is situated the town of Wilmington, a point of great strategic importance to the Southern cause, was the last port open to Confederate commerce. It may be entered by two channels, the north-east of which carries 8, and the south-west 12 feet at low water, subject to a rise of 3½ feet at neaps, and 5½ at spring tides. The north-east entrance called New Inlet is distant from the south-west one called Western Bar Channel about 8 miles in a straight line, or 10 miles by interior navigable channels. To pass from one to the other outside, however, a vessel must round the light-ship off the south-east end of the Frying Pan shoals, and traverse a distance of at least 40 miles. There were powerful forts at each entrance, but Fort Fisher at New Inlet being higher up the stream was necessarily the key of the position. It was situated on Federal Point, the north-east or land face about 530 yards in length, extended from within a short distance of the ocean, right across the neck of land which gradually narrows into Federal Point, from which the ocean salient angle was distant 1½ mile. The land face mounted 16 guns, and was heavily traversed with sand revetted with marsh sods. From the ocean salient a line of batteries fronting south-east and mounting 32 guns extended along the shore for 1,350 yards, terminating in an artificial hill of sand 52 feet high, called Mound Battery. The parapet at the salient was 15 feet above the sea level, and the traverses 28 feet above it. Western Bar Channel was commanded by some 30 heavy guns, mounted on Fort Caswell and Smith's Island. The same arrangement of the blockading squadrons, one of which was stationed off each entrance, seem to have obtained here, as at Charleston, but no sheltered anchorage was available. The Secretary of the United States Navy states: "Some idea of the difficulty of closing these entrances "may be formed, when it is considered that with fifty of our steamers, "some of them the fastest in the service, stationed and distributed off "these entrances by naval officers of intelligence and experience, "blockade runners, watching their opportunity, and availing themselves

[1] "Never Caught, &c." Roberts, 1867.

" of dark nights, good pilots, and extraordinary speed, have succeeded " in breaking the blockade."

It was finally considered that nothing but possession of the entrances could enable the port to be entirely closed to commerce. Hence, on December 14, 1864, a powerful naval force of fifty vessels under Rear-Admiral Porter, and a land force of 6,500 men under General Butler, prepared to concentrate against Fort Fisher. The co-operation, however, was very imperfect, and it was principally owing to this that the expedition withdrew again on the 27th December, having inflicted but trifling damage on Fort Fisher. A second expedition, with a land force of 8,000 men under General Terry, succeeded in effecting its capture, although the garrison had been increased to 2,300 men. It was subjected to a very severe bombardment and carried by assault on January 15, 1865, in spite of a most determined resistance protracted from 3 P.M. to 10 P.M., by holding each traverse in succession. Space forbids me to linger on this part of the subject, but full details will be found in the report of the Secretary of the United States Navy for 1865.

From the blockade of Charleston and Cape Fear River it appears :—

1. That a secure and commodious port within a moderate distance is essential to the effective conduct of a blockade.
2. That the blockading force actually on the spot must be sufficient to meet any force the enemy can send out, with a division of light ships available for intercepting others trying to escape under cover of the engagement. And that for this purpose a certain number of spare vessels for reliefs would be absolutely necessary, say one-third of the total force.
3. That the spar torpedo-boats, rude as they were, formed a very important item in the defences, but that the difficulty was effectually met by improvised defences rigged by the ships' companies.
4. That unless the channel of entry be continuously commanded by the blockader's guns or mines, an entirely effective blockade is impossible ; more or less of those attempting the passage may be captured, but if the inducement be sufficient, many will succeed in passing.
5. The possibility or not of obtaining such a command will depend upon the nature of the approaches, as regards depth of water, and the configuration of the land in the vicinity of the port. Harbours like Port Jackson or Milford Haven would be difficult, and ports like Liverpool easy to blockade, supposing the meteorological conditions similar.

V. I must now endeavour to form an estimate of the influence of the changes in armaments on the foregoing conclusions. The great increase in the power, range, and accuracy of guns makes it improbable that blockading ships will lie at anchor within 9,000 yards of important forts; and it is possible that by the aid of telescopic sights an even wider zone may be rendered unsafe; as an instance, the "Union" struck at over 8,000 yards by "Angamos'" 8-inch gun at Callao.

As regards shell-fire for silencing earthworks, it is doubtful if the present guns are more powerful, but they would be largely supplemented by machine-guns. A remark of Captain Fraser, R.E., seems very applicable to small detached maritime fortresses. "We "conclude, therefore, that the power of resistance of small fortresses "has relatively decreased, the more so as their defences are now exposed "to be bombarded in reverse by far-ranging guns."—R.E. "Prize "Essay," 1876.

VI. In no department of naval architecture has such remarkable progress been achieved as in that of small and rapid vessels. The sinking of the "Housatonic," February 17th, 1864, by Lieutenant Dixon, C.S., off Charleston, was accomplished in a submarine boat used on the surface, and propelled by manual power applied to a crank working a screw. In 1877, Mr. Donaldson gave us here a full account of the torpedo-boats made by Messrs. Thornycroft's firm, the pioneers in this department. Again, in 1879, Mr. Ravenhill gave us an account of Messrs. Yarrow's latest torpedo-boats, and full information up to the end of 1879 may be found in Mr. Sleeman's work. I have tabulated some information published in "Engineering,"[1] which may be useful to members, and some facts concerning consumption of coal kindly furnished by Messrs. Thornycroft, Yarrow, and Normand.

We thus see that a blockading squadron will have to contend with a swarm of boats capable of steaming at a speed of 22 knots 37 fs. ahead, of going astern 13 knots, and steering the while as well as with headway, and of turning the circle of a diameter of $3\frac{3}{4}$ lengths in less than $1\frac{1}{2}$ minute. Under the present system of propulsion, the use of coke gives a very slightly decreased speed with an absence of smoke. The experiment of hydraulic propulsion now in course of trial by Messrs. Thornycroft may show sufficiently satisfactory results as regards speed, with a safety against the fouling of the propeller, of great value in war. The fact that these boats as at present constructed can be perforated and disabled by machine-gun projectiles, is met by the equally ascertained fact that the first class boat loses speed only about $\frac{1}{4}$ knot by the addition of a ton weight. It is, therefore, evident that efficient protection to vital parts may be given at the cost of a slightly decreased speed or of an increase of driving power and cost. These boats carry three Whitehead torpedoes which can be discharged efficiently against a ship at a distance of from 300 to 400 yards, and they cost from 7,000*l.* to 8,000*l.*, while a first class ironclad costs from 300,000*l.* to 600,000*l.*

But greatly as the powers of the torpedo-boats have increased, the weapons they wield have received an equal increment of power. The self-propelling torpedo loaded with guncotton or other nitro-glycerine explosive to be detonated on contact, is as superior to the 60 lbs. of powder of the torpedo of 1864 as the boat which carries it is to the "David." The tendency is to enlarge the masses of explosive matter which can be launched against an enemy, and the only thing which prevents the use of shells from guns containing guncotton to be detonated on striking, appears to be the impossibility, in the present

[1] Appendix II.

state of the arts of war, of firing them without premature and disastrous explosion. This, however, does not extend to impulsive projection, and Mr. Ericson's destroyer, described by Mr. Sleeman, has, as lately reported, ejected a projectile of 1,500 lbs. weight, including a charge of 250 lbs. of explosive matter, which traversed the first 350 feet in three seconds. Captain Fraser, R.E.,[1] states that wooden cylinders, over 700 lbs. weight, have been fired on the Continent, from holes lined with battens, with charges about $\frac{1}{10}$th of the weight of the shell. They ranged for distances slightly over 350 yards, and only went about 12 inches into the ground on falling. Both the shells and their time fuzes were fired by electricity. Also that before the assault of a breach, means must be found for throwing in large masses of the new explosives, which by the shock of their detonation will clear away everything in their neighbourhood. It seems worth considering whether any similar means might be adapted for naval countermining. On the side of the defence as against the swift boats, a new weapon has appeared since the war of 1861–65. A kind of machine-gun was used at the siege of Fort Wagner, but of late this arm has been greatly improved.

VII. In a report of the Captain of H.M.S. "Excellent" of some trials at Spithead last year with a Nordenfelt and Hotchkiss machine-gun mounted on the forecastle of the "Medway" gunboat and fired at a model of a torpedo-boat, at speeds up to 8 knots, the following conclusions are recorded :—[2]

It would appear that in daylight, and at speeds up to 8 knots, it would be impossible for a torpedo-boat to approach a ship defended properly by the fire of either of these guns, provided the gunners were sufficiently trained, and remained cool and collected.

The number of hits also in any one run was so largely in excess of what would be required for the purpose of disabling a torpedo-boat that a very considerable margin is left, to balance the advantages which the attack would derive from greatly increased speed, confusion, or surprise on the part of the defence, and guns being worked by men not so well trained in their use as they were on this occasion.

It was remarked by observers who were in boats abreast of the targets, during the "end-on" runs Nos. 5, 6, 7, 8, that although the fire at first, more particularly in case of runs 5 and 6, and between 1,500 and 1,000 yards, was somewhat wild, several volleys and shells falling beyond, and others short of the mark, although even then some rounds were effective; yet directly the range and variation of elevation due to distance was obtained, the effect of the fire did not seem to be influenced much by the nearer approach of the gunboat, most of the shot and shell taking effect, and others falling short of the target until the range was reduced to from 400 to 300 yards, when the larger mark and growing confidence of the men in hitting it caused the rapidity of fire to be greatly increased, and nearly all the shot seemed to strike, and this when the change of position of target was greatest, and opportunity of observing most thorough.

[1] R. E. Prize Essay, 1876.
[2] Parliamentary Report.

The effect of the fire was that the iron rods placed in the sections to represent slide and piston rods of engines were nearly all cut through, or bent by shot and shell, and the boxes to represent steam chests were riddled.

By careful examination of the target boats, the great destruction of the end-on fire was plainly manifest. These runs were made at speeds up to 8 knots, and the rate of fire appears to have been—

Nordenfelt	..	..	42 rounds per minute.
Hotchkiss	..	..	14 „ „

At the trials for penetration in Portsmouth Harbour at 300 yards against a target representing the bow of a torpedo-boat from the stem as far aft as, and including the fore end of the boiler fired at end-on, the Hotchkiss 1-42-inch gun, steel shot, went through side of boat $\frac{1}{16}$ steel, four thin bulkheads each $\frac{1}{16}$ steel, and also the $\frac{1}{2}$-inch steel plate, representing the end of the boiler. The Nordenfelt 1-inch bullet got as far as the boiler plate, but failed to penetrate it. The remarkable fact about the projectile of both guns is, the extremely acute angle at which they will bite into the thin side plates. In one case a Nordenfelt bullet penetrated, making a large jagged hole, where the angle could not have been more than 10°.

From the above it is evident that the question of torpedo-boats *versus* machine-guns is still far from being decided; but it seems probable that the result must be an increase of weight in the boats, and a lowering of speed.

The recent exhaustive trials at Shoeburyness with machine-guns firing rifle ammunition, have shown the vast difference between firing at a moving and at a stationary object. When the target was drawn diagonally across the range from an initial distance of 800 yards at a speed of about 8·4 knots, the same guns which, when firing at a stationary mark, had struck it nearly every time, now (if we take the three ten-barrelled ones as the most favourable example) only hit once out of twenty-one shots, and took a mean time of five seconds per hit. The gun which made the best practice, the ten-barrelled Nordenfelt,[1] scored one hit for eleven-and-a-half shots, and made one in a small trifle under three seconds. Guns capable of perforating torpedo-boats would not fire so quickly; and if we add the effect of a vessel's movement, the boat would seem to have a fair chance at all ranges over 400 yards, when it appears from the Spithead experiments that greatly increased accuracy may be expected, and this might be predicted from a consideration of the trajectories alone. A torpedo-boat exposes 3 to 4 feet of freeboard, and at 400 yards the maximum height of trajectory begins to fall below that.

VIII. What modifications of the proceedings before Charleston and

[1] Weighing 256 lbs. { 4 barrel, 1 inch, 448 lbs.
2 „ „ 280 „
Gatling, 254 lbs. { 1 „ 1½ „ 224 „
2 „ 1½ „ 500 „
Pratt-Whitney, 261 lbs.
Hotchkiss 1·5 inch wt. = 441 lb.
1·85 „ wt. = 11 cwt.

Cape Fear would the improvements summarised below have necessitated? They are:

(*a.*) Great improvements in submarine and electro-contact mines.
(*b.*) Great improvements in torpedo boats and locomotive torpedoes.
(*c.*) Great increase in available illuminating power.
(*d.*) Great increase in power of covering a given space with man disabling missiles.
(*e.*) Great increase in range and accuracy of heavy guns.
(*f.*) Steadier gun platforms owing to progress in naval architecture.
(*g.*) Subaqueous injury more localised and less fatal, owing to watertight sub-division, except as against destroyers or large mines.

First taking the side of the garrison we find:

1st. (*a.*) Would enable them to close their channels against hostile ships, wherever a fort was at hand to protect the electric communications.
2nd. (*b.*) Would enable them constantly to harass the vessels on blockade, and to fire locomotive torpedoes at them from the shore if they entered a channel.
3rd. (*c.*) Would keep their passes and concentrating points for artillery amply illuminated in all weather but dense fog.
4th. (*d.*) Would make boat work within 1,000 yards of heavy batteries impracticable, except under shield cover.
5th. (*e.*) Would make the anchorage inside the bar of Charleston Harbour unsatisfactory, except for picket-ships, even after the capture of Morris Island.

Next taking the side of blockading squadrons:

1st. (*c.*) Would afford them both at Cape Fear and Charleston the power of so illuminating the arcs of approach that it would be almost impossible for a vessel to pass in clear weather, however dark.
2nd. (*b.*) Would enable them to fill the approaches with patrol boats and confine the garrison's torpedo-boats, or force them to engage their counterparts. This would make entry or egress more difficult.
3rd. At Charleston, the garrison would probably have numerous electro-contact and submarine mines in "Main-ship "Channel," and would cover them by heavy batteries on Morris Island, commanding the channel from the bar upwards. Now, (*f*) and (*e*) would enable them to obtain a superiority of fire over the batteries at the south end of Morris Island in conjunction with a land force on Folly Island. Next (*a*) and (*d*) would enable him to countermine the south end of the channel and clear it under cover of suitable vessels. Thirdly, moving his vessels into the space so cleared would enable him, in conjunction with his land force, to effect a lodgment and ultimately capture the batteries on the south end of Morris Island, which would then be

converted into a *tête de pont* for the attacking force, and under its fire would be placed submarine mines which would close the channel. In the meanwhile the other channels would have been sown broadcast with mechanical mines.

4th. At Cape Fear River, the garrison would possess an immense advantage from their two entrances, as, by acting on interior lines, they would compel the blockaders to keep a force off each entrance, capable of coping with the total inside force. In other respects, as they had no unoccupied channel, they would reap no further advantage from the improvements. Moreover, were a new Fort Fisher constructed, as suggested by Admiral Porter, 1 mile further in, (*e*) and (*f*) would enable the Power in command of the sea to enfilade the channel face from 4,000 yards, and the land face from 2,800 yards, with ample room for his vessels. The new artillery would necessitate the advance battery on Federal Point being covered by heavy fortifications on the west side of the river. Again (*d*) would place the low peninsula ending in Federal Point under command of ships.

5th. It appears, then, that where, as at Charleston, the navigable channel is suitable for submarine mining, and runs parallel and near to the land, ending in deep or disturbed waters within gunshot of the batteries, recent improvements are most favourable to the defence, for although points (1) and (2) are most strongly in favour of the attack, yet they are not decisive, in view of the vicissitudes of weather, hence the type of operations conducting to a decisive issue remaining the same, we find that for such places effective blockade will make greater demands on the assailant, and extend those demands over a longer period.

6th. On the other hand, where, as at Cape Fear River, there is no channel, but open sea external to the batteries, and the positions suitable for mining are under the command of those batteries, the conditions remain tolerably similar, but (*e*) would enable the garrison to command the left bank from the right one; (*e*) would also render the shelter of shore batteries of little use to merchant vessels, and the blockader would reap immense advantages under heads (1) and (2).

IX. Hitherto we have confined ourselves to historical cases, but examples of type (*a*) Sec. II, are wanting, and where this is the case, we are compelled to supplement historical lessons by imaginary instances. Admiral Jurien de la Gravière [1] tells us: "The imagina-"tion—who would have believed it?—has become, even in these "technical studies, a safer guide than routine. The torch she waves "serves at least to reveal the horizon." It remains then to consider the case of harbours of a different type by the light of the foregoing

[1] "La Station du Levant."

facts, and to sketch the conduct of a blockading fleet. There is an evident contrast between such a harbour as Sebastopol, and the low shores of those we have been considering; but before leaving them, let us suppose that the same shallow channels we have in view are prolonged beyond effective gun range from the shore. Here we have clearly, unless the owner, at a vast cost, build forts upon the sand, the advantage recounted under heading (1) for the garrison, transferred to the blockader, who moves up his armoured vessels, and closes the channel by submarine mines protected by their guns, possibly mooring an armoured torpedo lightship as a picket vessel. Turning to the other extreme, let us consider a harbour of the perfect kind. Such a one is Port Jackson, formed by nature for the head-quarters of a fleet. Its entrance about a mile wide, formed by cliffs from 200 to 300 feet high, steep to and forming part of a straight coast line, affords no possible advantage to a blockader, while it ensures an overwhelming fire against an enemy attempting to enter. The north head is, in fact, a natural fortress of enormous strength, flanked by another on its right rear. Compared to such a position, Sebastopol or Cronstadt sink into insignificance. In such a case we may imagine an Admiral quoting the words of Lord Collingwood,[1] written off Cadiz, December 9th, 1806: "I have little to tell you from here; the enemy's squadron "are quite ready for sea, but in the upper part of the harbour, out of "the way of storms; while we contrive to watch them, that they may "not go out without an encounter. A battle is really nothing to the "fatigue and anxiety of such a life as we lead. It is now nearly 13 "months since I let go an anchor, and, for what I see, it may be as "much longer."

At the same time if the conditions alluded to in Sec. IV are fulfilled, a blockade of more or less stringency, according to the meteorological conditions, may be instituted against a naval arsenal possessing such advantages. A squadron for such a purpose would require to be composed of:—

(*a.*) A number of first-class fighting ships, equal to those of the enemy, with one-third in reserve.

(*b.*) A number of vessels of "Hotspur" and "Polyphemus" type to cope with any such vessels possessed by the enemy and one-third in reserve.

(*c.*) A number of torpedo-boat ships, sufficient to ensure that in all suitable weather a barrier of patrol boats formed the advanced pickets of the fleet, and as the duties of the crews would be severe and incessant, it would be necessary that the same crew should never be on duty two nights running, but should have commodious quarters in a suitable vessel. Unarmoured vessels would be adapted for this service; their primary duty being to act as a base for the patrol boats.

The torpedo-boats of the fighting ships will thus be always ready for their proper duty, that of defending their own vessels.

[1] Selection from Lord Collingwood's letters.—G. G. Newnham Collingwood, F.R.S., 1828.

The torpedo-boat ships should be capable of hoisting up their boats when fully armed and provisioned, so that the delay of so doing may be reduced to a minimum. At least one of them should have a factory on board, of sufficient resources to repair any ordinary war damages to the boats.

The difficulty of the problem introduced by the locomotive torpedo is to prevent small and inexpensive vessels injuring large and expensive ones. So long as the enemy meets torpedo-boats with torpedo-boats, the forces are on equal footing; but if he make a vigorous attack with his boats supported by armoured vessels on the line of patrol boats, the armoured vessels in support would become engaged, and one or two small very fast lightly-armed vessels, capable of sea keeping in all weather, would be required to cut off any boats attempting to get out during the *mêlée*, and torpedo the first-class fighting ships. It seems, however, that the latter would, by moving very slowly, with torpedo netting down, be secure from attack by such boats.

An important problem presents itself here. How best to defend a vessel under way at night by the electric light?

Captain Abney, R.E., F.R.S., has pointed out the best position for the observer with reference to the light to be as close to the illuminated sector as possible, but at an angle of 60° with the axis of the beam. If we take the present range of Whiteheads as effective at 400 yards, the first condition is that no boat shall approach to that distance without being seen. A second condition is that the field of fire must be clear, so that an enemy approaching may get the full benefit of the battle-ship's fire. If we take the article on torpedo-boat tactics translated for us from the German last year by Mr. T. Brassey, M.P., as a fair sample, a division for attack is to consist of eleven boats, of which six are to expect to be sunk, even if the attack is successful. Now part of my tactics has already been laid down to consist in having such a quantity of patrol boats in the front line that none but exceptionally fortunate ones could pass. It is true that the blockader's boats would be second-class ones, unless his base were within 100 miles, in which case he might have as many first-class ones as the blockaded squadron; but considering the vicissitudes of weather, he would probably do best with boats he could hoist up, and make up in number for want of speed. It does not appear expedient for the ship to be protected to exhibit a light herself.[1] Its great height would serve as a leading mark to her from a great distance and if she had three, as has been recommended, flashing in various directions, the eyes of all look-out men would be dazzled and bewildered. She must then surround herself with an illuminated space at the proper distance, and this can be done by her boats, or if she be stationary, by projecting light balls from a mortar or gun. I assume it would be done with her boats. Two boats must be stationed together on opposite sides as shown in Fig. 1 or 2. In both a circle of 400 yards radius is drawn round the vessel, and the axes of the electric beams are to form tangents to the circle. In Fig. 1 they form a circumscribing square. In Fig. 2 an equilateral parallelogram. In Fig. 1 the

[1] Her own lights would be in reserve to play upon a discovered enemy.

ship's centre bears 45° from the axis of the beam; and in Fig. 2, 60°. I prefer Fig. 1 because the distance of the ship from the axis of the beam varies only from 400 yards to 570 yards; whereas in Fig. 2 it varies from 400 yards to 800 yards, and it seems unlikely that a difference of 15° in bearing could greatly affect a ship's power of sight, but experiment alone could decide such a question. I assume the beams to have an

FIG. 1.

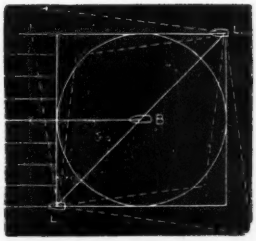
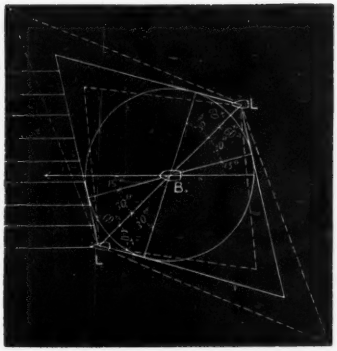


FIG. 2.



B—Battle-ship. → Course.
L—Source of light in a boat.
Limits of beams dotted.
Axes of ditto plain.
Scale ¼ inch = 100 yds. $\frac{1}{114\frac{1}{300}}$.

azimuth of 15° and a vertical plane of 5°. Being low down, the ship's look-out men would have the advantage of the depth as well as breadth. It is also worth remarking that, after practice in station keeping and illuminating, the certainty as to range would be a great point in favour of this method.

It would be possible so to connect a number of divergent machine-

gun barrels that the shots at each discharge should strike every part of a transverse section of the beam, and thus make hitting an object in the line of fire a certainty. It is hitting an object for certain in a given time that is needed, the table shows the time a torpedo-boat at 20 knots would be crossing such a beam on opposite course to ship.[1] The fire of the boats in line with the beam would be formidable against an enemy passing close, and if the enemy pass far from the source of light, he is longer illuminated. It is obvious that though the ship could not fire towards the boats, they could fire towards the ship, and it would be advisable to have a third boat at each light station, to keep in the prolongation of the line joining lights and ship, act as an outlying picket to the light boats, and give increased fire at those points. A boat 50 feet long, steering parallel to the ship, would, if placed as in Fig. 1, subtend an angle of less than 5° from the ship's centre, and experiment would show within what limits the ship's fire must be restricted, considering her length, not more than 15° should be masked, hence the battle-ship could fire around 330° and the boats round the whole circle. Thus I leave the battle-ship, steaming as slowly as possible, with torpedo netting down and outriggers out, six boats on patrol, and machine-guns, wall pieces and rifles, ready to pour a stream of projectiles on any intruders. It has been said that ships could not carry netting out while under way, but I think this merely a question of speed and fitting. If the blockader possessed a secure harbour close at hand he would certainly keep his heavy vessels there, defended by obstructions and mines, and perchance in telegraphic communication with the commander of his advanced squadron; but failing such accommodation, he must either relinquish the blockade, or preserve a naval superiority on the spot. Ships in such a case would only need steerage way, to keep them in station for the advanced squadron to fall back on, if the enemy emerged in force. On necessity occurring, the outriggers should go up by steam and the netting fall into suitable crutches placed round the vessel above the water-line. A current of over 4 knots is found in the Medway, and no more speed would be required under the circumstances contemplated. The only alternative to such protection is speed, which is impracticable under such circumstances. The adoption of torpedo-boats as part of the defences of a maritime fortress would render such reconnaissances as we read of during the Russian War impracticable, and very high speed would be necessary in a ship charged with such duties. There remains the case of fog, equally adverse to both sides, except in the case of vessels coming out; but the battle-ships should change their position and keep quiet, while the patrol boats would form a chain and keep up communication by sound. One of the points needing most careful arrangement would be the system of rendezvous, and precautions against mistaking a friend for an enemy, and *vice versâ*, where such numbers of boats would be under steam. I think that with patrol boats on the alert and closed up, near the entrance as they could be under cover of fog, such instances of escape as that narrated by Captain Roberts from New Inlet at 4 P.M.

[1] Supposing B is going 4 knots.

could not occur, and fogs are seldom accompanied by strong winds.

Such vessels as the blockade runners of the war of 1861–65 are widely different from men-of-war, being only 8 feet out of the water and burning anthracite coal with a forced draught; they would be visible but at a short distance and offer a small target. The precautions taken and extraordinary escapes are interesting and instructive. I have been told by an Officer who served on the blockade, that the bow wave was frequently the only visible thing about a vessel at night, and in all such operations, the position of the side with regard to any source of light is an important point. Another advantage which the electric light would give the blockaders, is the extended range it would afford for night signals, whereby a vessel passing one enemy would immediately be signalled to all the rest, fully half-an-hour in advance. Rockets and blue lights appear to have been the principal means of communication at night with the Federals. It must also be observed that if the blockader has enough vessels he may place some about the limit of a night's run, according to the state of the moon, from the blockaded port; these might extend over an arc and with the aid in fine weather of captive balloons, might watch a large surface and pick up many ships who had passed the first line. The main dependence, however, must always be on narrowing the approach as much as possible and covering a small portion of it through which ships cannot pass unseen, with an overwhelming fire.

X. To sum up, then, it appears that where it is required to institute a blockade, the best mode to render it efficient is to seize an island or point commanding the channel, and lay down electro-contact mines. Where this is impracticable, but the channel narrow and extending far from land, to lay down mines resting on a floating base. Where neither are possible, organize a suitable squadron, with numbers of light swift vessels, resting on a favourable base, and after practice and with a fair proportion of time off duty, it is probable that a fairly efficient blockade would be maintained, and that squadrons would find it more difficult to escape unperceived than formerly. Every increase of speed and of economy of coal[1] brings a maritime Power nearer its base and makes it easier to concentrate on a given point by telegraph. One of the dangers of extended blockades is that of a squadron escaping from one port, and taking that blockading another port between two fires, which could always be arranged beforehand with far more certainty than in the time of the famous naval combination of Napoleon I. In future wars the Navy may have to draw largely upon the experience of the great Telegraph Companies and the Trinity House, and I cannot conclude better than by quoting the words of Lord Nelson[2] when in command of the squadron opposed to the Boulogne flotilla, September, 1801: "Care should be taken to keep our "squadrons compact and in good order . . . . . never to risk being "crippled or driven into the North Seas; thus we shall always be sure "of an effective force, ready to act whenever the occasion calls for it."

[1] See Appendix for "Probable Coal Consumption of a Blockading Squadron."

[2] "Despatches and Letters of Lord Nelson," Sir H. Nicolas, vol. iv, p. 484.

APPENDIX I.

STATEMENT OF FIRING BY U. S. STEAMER "NEW IRONSIDES." L. 220, B. 60. M.D. 15¾ FT. ARMOUR, 4½ IN. ARMAMENT, 14 11 IN.; AND 2 150-PRS. D. 3,296 TONS. OFF CHARLESTON HARBOUR.

Date.	Rounds Fired.	Hits by Enemy.	Distance.	Object.	Remarks.
1863.			Yards.		
July 18	805	4	1,400	Fort Wagner ..	At anchor.
20	168	13	1,300	„ ..	„
24	464	5	1,200	„ ..	„
29	183	2	1,200	„ ..	„
29	25	..	2,500	Fort Sumter ..	50-pr. on spar deck.
29	2	..	1,900	Fort Gregg ..	„
30	329	2	1,800	„ ..	At anchor.
30	1	..	2,250	Fort Sumter	50-pr. rifled on spar deck.
Aug. 17	400	31	900	Fort Wagner	Most hits from 10 in. guns in Wagner and Gregg.
17	30	..	1,700	Fort Gregg ..	
17	2	..	2,700	Fort Sumter ..	50-pr. rifled.
18	118	..	1,200 to 1,400	Fort Wagner ..	Under way.
19	50	..	1,100	„ ..	At anchor.
20	158	..	1,150	„ ..	„
20	2	..	3,400	Confedt. steamers	50-pr. rifled on spar deck.
21	70	1	1,300	Fort Wagner	Hit by Sumter's 11-in. solid shot.
22	115	..	1,100 to 1,300	„ ..	Under way.
23	90	4	1,100 to 1,300	„ ..	„
Sept. 2	41	7	1,000	Fort Gregg	Night, ship at anchor, hits from Gregg and Moultrie.
2	9	..	1,500	Fort Sumter ..	
5	488	..	1,300	Fort Wagner ..	At anchor.
5	32	1	1,800	Fort Gregg ..	Hit by Gregg.
6	184	..	1,300	Fort Wagner ..	Firing to noon.
6	38	..	1,300	„	At anchor noon to sunset.
7	152	24	1,200	Fort Moultrie	Anchored at night. Wechawken ashore.
8	483	70	1,200	„	Anchored. Hits on 7th and 8th from Sullivan Island Batteries.
On 17 days	4,439	164			14 days at anchor. 2 nights at anchor. 3 days under way.
Under-way	323	4			
Anchor, day	3,923	129			
Anchor, night	193	31			

SERVICE OF IRONCLADS, SOUTH ATLANTIC BLOCKADING SQUADRON. SHOTS FIRED, AND HITS RECEIVED BY THEM DURING OPERATIONS AGAINST MORRIS ISLAND.

Vessels.	No. of Shots Fired. 15-in. 400-pr.	No. of Shots Fired. 11-in. 170-pr.	Hits.	Hits April 7, 1863.	Hits at Ogeechee	Total Hits.
Catskill .. .. (About 1,200 tons D.)	138	425	86	20	..	106
Montauk .. .. (About 1,200 tons D.)	301	478	154	14	46	214
Lehigh .. .. (About 1,200 tons D.)	41	28	36	..	..	36
Passaic .. .. (About 1,200 tons D.)	126	243	93	35	9	247
	119	107	90			134
Nahant .. .. (About 1,200 tons D.)	170	276	69	36	..	105
Patapsco .. .. (About 1,200 tons D.)	178	230	96	47	1	144
Weehawken .. (About 1,200 tons D.)	264	633	134	53	..	187
Nantucket .. (About 1,200 tons D.)	44	155	53	51	..	104
Ironsides 3,296 tons D..	..	4,439	164	..	..	164
Total mounting of 9 ships, viz. :—22 11-in., 8 15-in.—30 guns, and 2 150-pr. rifles.	1,255	6,771	882	256	56	1,194

NOTE.—This gives 157 rounds each 15-inch, and 308 rounds each 11-inch.

Compare "Weehawken" and "New Ironsides" displacements 1,200 to 3,296 tons.
Surface of exposed longitudinal vertical plane is 448 and 2,860 square feet.
" transverse " 253 and 780 "
" submerged longitudinal " 2,300 and 3,465 "
" " transverse " 517 and 945 "

As targets "Weehawken" offers above water only 15·6 per cent. of the surface "New Ironsides" does, broadside-on, and 32·4 per cent. of what she does end-on.

As submarine targets "Weehawken" offers broadside on 66·3 per cent. of what "New Ironsides" does, and end on 54·7 per cent.

"Weehawken's" reserve buoyancy is about 216 tons or $\frac{1}{10}$th total.
"New Ironsides" " " 2,200 tons or $\frac{2}{3}$rds. total.
"Weehawken" carried 12·5 per cent. of guns of "New Ironsides."
" fired 20·2 " of shots of "
" was hit 81·7 " of times of "

APPENDIX II.

Mr. Yarrow has kindly supplied the following information as to his boats :—

Coal consumption varies very considerably. At the maximum speeds it is about $3\frac{1}{2}$ lbs. per I. H. P. per hour, say from 17 to 18 cwt. per hour. For long runs at a slow speed, however, the economy is very great, and we have recently tried some experiments bearing upon this point with our 100 feet torpedo-boats, and find 1 ton of coal is

APPENDIX II.

Boat builder and date of Trials.	Tons Displacement.	Dimensions, feet.				Nature of Trial.	Speed of Boat.	I.H.P.
		Length.	Beam.	Mean draught.	Maximum draught.			
Messrs. Normand & Co. Havre, No. 20. 23 | 9 | 78.	31·1	89·0	10·83	2·82	5·97	Three hours	Knots. 18·27	...
Ditto, No. 21. 3 | 3 | 79.	Same. In dra	Messrs. ught gi	Norman ven is a	d's boats midship	the s.	French Government	19·42	468
Ditto, No. 27. 22 | 4 | 79.	38·0	103·0	10·83	2·69	5·9	...	18·33	440
Ditto, No. 41. 10 | 3 | 80.	33·3	89·0	10·83	2·95	6·17	...	19·31	...
Ditto, No. 42. 23 | 2 | 80.	...	Same.		...	...	...	19·88	...
Ditto, No. 47. 16 | 6 | 80.	31·8	89·0	10·83	2·85	6·07	...	18·59	...
Ditto, No. 48. 12 | 7 | 80.	...	Same.		...	...	...	19·71	..
Ditto, No. 49. 27 | 8 | 80.	...	Same.		...	...	...	19·78	...
Mr. Thornycroft. 15 | 1 | 80.	29·73	At 89·33	L. W. L. 9·46	2·28	about 3·0	Preliminary mean of 6 runs.	22·01	460
Same boat.	32·5	...	...	...	...	Official mean of 6 runs on mile.	21·75	469
Trial by H.M. Dockyard officials to ascertain consumption.	...	...	...	...	...	...	18·75	340
Messrs. Yarrows. Oct. 1879.	27·0	86·0 At 82·0	11·0 L. W. L. 10·0	... 2·79	...	Trials to ascertain relations of I.H.P. and speed.	13·3	94·9
Co-efft. of fineness, this boat 40.	Same boat.			2·79	...		14·25	125·5
Ditto.	...	...	...	...	...		15·3	164·4
Ditto.	...	...	...	...	...		16·2	196·8
Ditto.	...	...	...	...	...		17·0	233·3
Ditto.	...	...	...	...	...		17·5	271·0
Ditto.	...	...	...	...	...		18·25	317·3
Ditto.	...	...	...	...	...		19·0	365·0
Ditto.	...	...	...	...	...		19·5	401·4
Ditto.	Maximum speed attained by this boat 21·9 knots.						20·0	425·2
H.M. Twin-screw diagonal wood built.	7·6	48·0	9·25	3·04	3·41	Mile trial.	over 13·0	120·0

TORPEDO BOATS.

Coal, lbs. consumed per hour.	Coal, lbs. per I.H.P. per hour.	Boiler Pressure,	Vacuum in Condenser.	Revolutions per minute.	Air pressure in inches water.	Remarks.
		lbs.	in.			
1,850	...	123	24½	313·1	...	Engines compound surface condensing, water circulated by motion of boat.
1,290	2·75	123	26	339·2	3¼	
1,065	2·42	119	27½	336·5	2	
1,200	...	124	28¾	325·2	3½	
1,290	...	122	28½	323·6	3	
1,170	...	118	27¾	307·7	1⅞	
1,250	...	126	28½	313·7	2⅞	
1,250	...	128	27½	324·3	2½	
...	...	123	24½	438·5	...	In Admiralty experiments with boiler of one of these boats, air pressures in the ash pits were 1·47, 2·29, 3·26, and 5·25 inches of water, the corresponding consumption of coal per hour being 925, 1,177, 1,472, 1,815 lbs.
...	...	133·8	23·8	443	...	
1,333	3·92	Not including I.H.P. used for fan and circulating engine.				
...	...	40	28	268	Pressures from 2 to 6 inches.	
...	...	50	27·5	280		
...	...	60	27·2	310		
...	...	70	27	330		
...	...	80	27	352		
...	...	90	26	374		
...	...	100	26	397		
...	...	110	25	420		
...	...	120	24	442		50 I.H.P. consumed in working fan engine.
...	...	130	23·5	460		
...	...	120	...	340		

sufficient for a run of 100 miles at the rate of 12 to 13 miles per hour, and no doubt at a slower speed a still greater distance could be run.

In order to obtain the best results in economy at slow speeds it is necessary to work at a full boiler pressure and work the engines with the greatest possible degree of expansion. If instead of doing this the boiler pressure is low and the expansion small, at these slow speeds it is found to be almost as much as double the consumption.

These boats carry 10 tons or more of fuel, from which it will be seen they are capable of going considerable distances without coaling.

Mr. Yarrow has imported anthracite coal from the United States, but has not found it answer well in the boats.

The newest type of boats carry three Whitehead torpedoes, the orifices lying together and somewhat countersunk from the upper part of the stem. The whole are covered by a cap which can be raised at pleasure. The funnels are made to point nearly horizontally at an angle with the keel aft of about 30°. The cost of a first class boat approximates to 8,000*l*. Boats are building for the Austrian, Italian, Dutch, Portuguese, Brazilian, and Greek Governments.

Messrs. John L. Thornycroft kindly supply the following information as to boats built by them:—

Coal-carrying power:—

1st class boats, say 5 tons.
2nd class boats, „ 1½ „

Coal consumption:—

1st class boats at	12·8	knots per hour,	500	lbs. per hour.
„	13·81	„	564	„
„	20·07	„	1,647	„
2nd class boats	17·00	„	421	„

Captain Tuxen, of the Danish Navy, narrates a most successful voyage from Gravesend to Copenhagen *viâ* the Eider Canal, coaling once; weather principally fine. As stokers had been forgotten in the crew brought from Copenhagen, two sailors performed the work satisfactorily under the Engineer and Captain.

Passage of No. 5 first class boat from Spithead to Plymouth in 10½ hours under command of Lieutenant Roxby; weather foggy first part of the time. There were 5 tons of coal on board, and the average consumption for an hour was 8 cwt. Sea perfectly smooth, except when nearing the Start, when a slight swell was encountered. Account states that after passing the Needles to Plymouth Sound a mean speed of 18 miles was maintained. The distance being 118′ if 8½ hours are allowed, it would make rather below 14 knots over the ground, but the actual route taken may have been longer.

The following results of turning experiments made at Chatham with one of Messrs. Yarrow's boats fitted with his drop balance bow rudder is extracted from the *Engineer* of January 29th, 1880.

Length of boat, 86 feet; area of stern rudder, 1,500 sq. in.; area of bow drop balance rudder, 500 sq. in.

At a speed of about 19 knots the mean time of turning circles to port and starboard was, with stern rudder, only 2 min. 10 secs., the diameter of circle being 196 yards. At same speed, using both rudders, the time was 1 min. 21 secs., and diameter 107 yards.

At a speed of about 14 knots, using after rudder only, the mean time of turning port and starboard circles was 2 min. 18 secs., and the diameter 178 yards. At same speed, using both rudders, the mean time was 1 min. 44 secs., and the diameter 99 yards.

APPENDIX III.

PROBABLE COAL CONSUMPTION PER DIEM, IN TONS, OF A BLOCKADING SQUADRON IRRESPECTIVE OF CHASING.

Number and Description of Vessels.	Steaming.	Cooking.	Condensing.	Total.
Three 1st class Battle-ships .. .. each	24	·25	·5	74½
Six 2nd „ .. .. .. „	18	·2	·4	111½
Two fast chasing ships .. .. .. „	14	·2	·3	29
Six torpedo and patrol boat ships .. .. „	14	·25	·5	88½
Sixty torpedo and patrol boats .. .. „	1	..	..	60
Seventeen ships and sixty boats under steam ..	71 one of	·9 each	1·7 class	363½

Say, 2,541 tons a week, or 132,132 tons a year; and large additional quantities would be required at the base to provide for chasing, attacks, &c.

Lieutenant BETHELL, R.N.: There are one or two remarks I should like to make, not as to the detail of the lecture which we have just heard, but on the general subject. The lecturer speaks of its being necessary in blockading to have one-third of the ships spare. Now as ships are at present constituted that is a very serious consideration, because they are so very scarce; and the reason for requiring that the blockading squadron should have one-third of its ships spare must evidently be the necessity of sending their ships away to get coal and stores. It appears to me that it is quite possible that stores should be brought to the blockading ships, and thus you would save a considerable number of vessels in these operations. The necessity of providing squadrons with coal and other stores necessarily forces itself upon the mind of any man who has thought upon these subjects; and there is no doubt if we were engaged in war, some system would have to be arranged by which coal could be supplied. I should, therefore, hesitate to assent to the lecturer's decision as to the proportion of ships that should not be engaged in blockading.[1] One other very interesting point is the use of the electric light in the

[1] The idea I intended to convey in this sentence was, that the necessity of providing a blockading squadron with a proportion of vessels more than actually required for the blockade, is, in my opinion, over-estimated.

blockading squadron. Captain Long says, and it is no doubt true, that if the ship that is to be attacked uses her light, she renders herself a very conspicuous mark, and he suggests that the light should be exhibited from some other point; but it appears to me since the illuminated radius which would be given by a light from another point would be so very quickly crossed by a torpedo-boat, it would be practically impossible for a vessel about to be attacked to concentrate her fire on the boats about to cross, and therefore I should say that it would be desirable for the vessel herself to show the light. One other point I may just allude to is, the system of throwing hawsers and spars around the ships. This is a manœuvre that takes a considerable time, and it is suggested that they should be hoisted up by steam and laid alongside the ship. Now that would be a very good thing, but I should think it might be still more quickly done and better arranged by means of a stout steel telescopic rod that should be made to slide in and out of the vessel. There is no doubt such a thing could be done, and if the system of spars and hawsers is at all useful, that system should be applied which can be carried out in the quickest way.

Captain CYPRIAN BRIDGE, R.N.: I think the Officer who has just spoken drew attention to a very important point, namely, the necessity of having your blockading squadron of sufficient strength to enable you to withdraw a part of it at a time to replenish supplies of coal and other stores. At the same time I do not think the reason he gave is the only one why it is absolutely necessary that you should have 30 per cent. more force than that which you are attempting to blockade, or, as he says, "one-third spare." In the two cases which Captain Long dwelt upon particularly in his lecture—the blockades of Wilmington and of Charleston—I think he said the blockading squadron had a base in each case some 50 or 60 miles off.

Captain LONG: 80 in one case and 55 in the other.

Captain BRIDGE: That was not more than a few hours' steaming for even very slow vessels, and it would not have been necessary (in order to replenish the stock of coal) to remove any large force at one time; so, therefore, if the base of operation is selected, as it should be at no great distance—for otherwise it would be very unwise to attempt to blockade a great naval fortress—that difficulty would not arise. But I think there is another very much stronger reason, indeed there are many other reasons why you should have a great superiority of force—in addition to the undoubted necessity of having to withdraw your ships from time to time to replenish their supplies, as they cannot be expected to do it within range of the enemy's guns, and that is, the multiplicity of accidents to which ships keeping the sea for months together are liable, and the absolute necessity of having a reserve upon which you may draw to make up for these accidents. It is very curious that until to-day I do not think there has been any paper read for years in this Institution specially devoted to this subject, and that I take as rather a proof that a very small amount of attention has been devoted to the attack of fortresses by ships in our Service. Some four years ago I investigated the question myself, and I cannot say that my labours resulted in anything of any value, for the simple reason that I had nowhere to go for information. I found that the study of the naval attack of fortresses was absolutely and entirely neglected amongst the Officers of the British Navy of late years: there was nothing which anybody had written or said to which I could refer which gave us any information at all. Incidentally there are certain papers, such as those on the American Civil War, in which it has been dealt with; but there was no deliberate attempt made to tackle the question; and one of the things which came out most obviously in examining the question with the very poor light thrown upon it up to that time, was the absolute necessity of having an enormous reserve of force. I do not think anybody who has not examined the question with the view of finding out up to what standard he should bring his force, can have any conception of the immense force that is required. For instance, take the war in America. The Federals were engaged with an enemy which was not in the least degree a naval enemy. I do not think he had half-a-dozen *bonâ fide* sea-going ships amongst the whole; but notwithstanding that, the Federals had to increase their ships from something under 100 to over 400, and the number of men from 7,000 to over 40,000. Of course the whole of the naval warfare in which they were engaged was fortress warfare—warfare against fortresses or land defences—and, therefore, as you may imagine, if we were to find ourselves engaged in a war with an enemy with a

navy and naval fortresses, and a certain number of sea-going ships able to attack those interests which it would be one of our most important duties to defend, we should see the utter inadequacy of anything like the present number of ships that we have actually in existence and building, or that could be quickly prepared for commission, to make any satisfactory attempt at shutting up the enemy's fleet in his own ports. I must say I admired very much Captain Long's proposal for illuminating the area round the ship with the electric light. Rather more than a year ago I witnessed the torpedo operations by night at Portsmouth. I accompanied a large number of Officers of the Army, and I think every person present was struck by the extreme weakness of the electric light; not that it did not illuminate the area and point out the boats as they came up fairly well, but it was such a terrible foe to the people using it, for it pointed out exactly where they were. I understand some experiments were made at Shoeburyness, by which it was found that the use of the electric light positively enables the enemy to make absolutely certain of hitting with his guns. By placing a sheet of white paper on which the beam of light should fall behind the sights of the gun, and letting the shadows of the two sights fall upon this paper, moving the gun until the points of the sights become exactly coincident, if your gun has any accuracy at all, you must hit the object aimed at. Therefore it is essential that the electric light should be removed to a distance from the ship or fort which you intend to defend against guns. If you do not do anything else but explode a shell pretty close to it, you will probably put it out and render it useless, but in all probability you will hit the ship; and if what I was told was correct, I do not think it is possible to miss it.[1] There was one observation made by Captain Long as to which he may perhaps give us some further information. He said that some attempts were being made to further develop the hydraulic system of propulsion. I am one of that very small minority of people connected with the sea who think it a most unfortunate thing that the hydraulic system of propulsion should have been so discredited as it has been. My only knowledge and experience of it are derived from having made a certain number of short cruizes in the despised and, it must be added, not very efficient "Waterwitch;" but in spite of seeing it under most unfavourable circumstances, I carried away a recollection of it which makes me think that it is a thing which we ought certainly to know more about. We had an instance in the paper which has been read, of a ship getting her screw fouled and having to anchor for fear she would have gone on shore or got amongst torpedoes. Now fouling appears to be absolutely impossible with a hydraulic propeller. I do not think during the war, of which Captain Long has related so many instances, there were any double-screw vessels used, if so, they were very few indeed. The screw vessels used were vessels with screws at the very least half as liable to be fouled as a great many of the ships we have in the Service at this moment; that is to say, they had one screw instead of two, and that screw being in a hole was more protected against fouling than one protruding from either quarter. In addition to that another advantage of the hydraulic system of propulsion is that it is under absolute control, and the Officer of the watch, or the Captain, or anybody stationed to do so, can with his own hand in a second stop the ship, turn her ahead, make her go to starboard, spin her round in her own length, or to port, or make her go slow, or anything you like, without the help of the engineer. Let people say what they like about its being uneconomical,[2] for us that is not the question. What we want is efficiency. If we can get efficiency with economy, by

[1] In these days, of course, no coast fortress likely to be attacked would be without the means of accurately ascertaining the distance of a ship which might come within range of its guns and within the arc covered by its obstructions. Of late years great care has been taken to ensure the garrison's being able to discover such distance. In the case of fortresses so placed that hydrographical conditions permit ships to assail them, the chart and the lead—even if the usual marks were invisible—have long given the crews the means of ascertaining the distance with reasonable exactness. Where this is not so, a naval attack on the fortress is not likely to be made.—C. A. G. B.

[2] Uneconomical of power.—C. A. G. B.

all means let us have it; but if we cannot, by all means let us have efficiency first. With regard to the effect of torpedoes, I do not think there is a well-established instance on record of any ship being destroyed or injured by a locomotive torpedo. There is one case said to have taken place at Batoum, but that has been distinctly denied by the people said to have lost their ship—the Turks; but as the question is in dispute, it would be rather interesting to know if it really did happen, because, if not, although the locomotive torpedo has been used on several occasions in earnest, there is no evidence that it has ever done any injury to a ship. Knowing that, and knowing also the very small number of cases in which under favourable circumstances the spar-torpedo or the fast torpedo-boat of comparatively modern type has succeeded—it very rarely having succeeded where proper precautions against it were taken—I think we may to a certain extent modify our views about the enormous efficiency of the torpedo as a method of attack. I am not saying anything about it as a weapon of defence. And we ought also to remember that not only were the circumstances under which torpedo attacks were made in the late war in the south-east of Europe favourable from the want of discipline or peculiar habits of the people assailed, but they were not made in the face of modern machine-guns. A Commission of Swedish Officers reported some year or two ago that machine-guns, such as they were then, appeared to render it practically impossible to make a torpedo attack by daylight against ships armed with them. If I read the reports in the "Times" aright, and they have been given very fully and bear accuracy on the face of them, the machine-guns lately tried at Shoeburyness are very much more efficient and formidable than anything in existence even as lately as 1879. Therefore it seems that these are the facts:—that no locomotive torpedo used in earnest has ever succeeded; that the number of torpedo attacks where proper precautions have been taken which have been successful is exceedingly small, and are likely to be still smaller if carried out in the face of a defence well provided with the very newest weapons.

The CHAIRMAN: Before I call upon Captain Long to reply to the observations that have been made, I will make one or two short remarks myself. I certainly think that to lay down any law as to the conduct of a blockade is absolutely impossible, excepting in the most general way. The locality must be considered, and the character and object of the blockade sought to be established may vary almost as much as the locality. The American blockade was peculiar in itself, and its circumstances and object. Captain Long has favoured us with some very interesting anecdotes connected with it, but the fact is, it was very different from any blockade that ever preceded or is likely to succeed it. In the first place, the Federal force was entirely inadequate to the blockade which the Government endeavoured to undertake, and, on the other hand, the object and tactics of the Confederates were different also from those of most previous defensive operations. Blockades may be established, and have been established for the purpose first of all of keeping an enemy's fleet inside her port; sealing them up as in the blockade of the Baltic, where Sir Charles Napier was under orders to endeavour to keep the enemy in his ports. Again, it may be established for the very opposite purpose of inducing them to come out to sea for the purpose of bringing on an action, as was the case with Nelson off Cadiz. A blockade may be established for the simple purpose of preventing supplies being thrown into an enemy's country, or it may have a twofold object, as in the American War, where the latter object was combined with another one, that of attacking the enemy in his own territory. A blockade would also depend very much on the relative force at sea of the two belligerents. The blockades we have generally had to do with in the past have been those with the object not of sealing the enemy up in his ports, but of inducing him to come to sea for the purpose of bringing him to action, or of preventing his escape on the ocean to attack our commerce and distant colonies. This was certainly absent from the object of the Confederates on the occasion referred to. They never wanted to send ships of war to sea, not even privateers from the blockaded ports. Our object has been to catch ships going out, and prevent them roaming over the seas, and I think in the carrying out of any future blockade we shall have much greater facility for carrying out that object than we had in the past, because when it was done under sail, ships were constantly blown off either by winds from the weather shore, or had

to keep off the lee shore, and in the interval of their absence the enemy escaped. Under present circumstances such a blockade can be maintained much more easily; ships will keep their stations not only more constantly but closer in shore, and even if the enemy does escape, whereas in former times there was no knowing where they had got to (we all know the stories of Nelson going about all over the world after them), now-a-days, with the increased facilities of inter-communication all over the world, and the vast fleet of despatch vessels we have at our command, we shall ascertain where they are in no time. So much for blockades of that description. If we come to the tactics which we should have to adopt in the event of our ports being blockaded, there have been two or three very apposite remarks made with which I entirely concur. If you consider the danger to which our own ports are subjected of being blockaded, let us ask who is to blockade them? I am very well aware that there is a section of the mercantile community of this country, great alarmists, who have no faith in the British Navy or its power, and in their panic, just like a drowning man catching at a straw, they grasp at something just as flimsy and powerless to save, viz., a simple piece of paper that they call a "Declaration" which is, I think, the most mistaken, and I should say mischievous, if I did not think it futile, instrument that this country was ever drawn into agreeing to. I may just say in passing I condemn it as false in principle and in fact, but I shall not expatiate upon it now because I suppose it might be considered outside our subject, although it does refer to blockades; but I must just remark that this beautiful valid piece of paper was signed in 1856. The first Article says privateering is and remains abolished for ever, and in 1862 and 1863 the Confederate States of America snapped their fingers at it, and the "Alabama" campaign ensued; surely that is quite enough to prove it ridiculous. To revert to the alarmists who cling to the protection of the Declaration of Paris, I myself entertain a different creed from theirs. I am not yet quite convinced of the imbecility, or the disappearance of the English fleet. Captain Bridge has just referred to the "enormous" superiority of force necessary for attacking or blockading a fortress with efficiency. Now, where is that amount of superiority to the British Navy to be found? As to the safety of our commerce at sea, I am tired of the vainglorious boast of Britannia ruling the waves, but I do protest against the idea of "Alabamas" doing so—we have not come to that yet at any rate. Gentlemen conjure up in their disturbed minds a phantom fleet, they do not believe in the real fleet of England, but they do believe in a phantom fleet of "Alabamas;" where are they to come from? One came once from England, and cost us some three millions, I believe; where are they to come from again as against ourselves, or what country is to find money for their production? I should like to comfort these gentlemen by telling them how they may get their protection. I think I can refer them to a more substantial one than a Declaration. What is a Declaration? It is not even a Treaty, and if it were, what has become of the Treaty of Sebastopol, which excluded the Russian fleet from the Black Sea? It is not an Act of Parliament, and if it were, what is an Act of Parliament but a document for a coach and four to be driven through every line of it, and to be cancelled. The moment the shoe pinches, or it is found inconvenient, I will tell these gentlemen where they can get their protection very simply and cheaply, with little trouble and less expense. They have nothing to do but to ascertain by means of their numberless and ubiquitous agents and correspondents all over the world where these "Alabamas" are building or being equipped for sea, and if the Admiralty do not provide two "Kearsages" for every one of them, they ought to be impeached. I do not mean, of course, they are to provide two men-of-war for every privateer, but I do mean to say they are to provide a force sufficient to draw all the teeth out of these wolves before they can much injure the sheep; they are only imaginary ones after all. There is, however, a weak point which has been alluded to, viz., the security of our foreign coaling stations, to which I would gladly draw attention. In spite of the Declaration of Paris, which says that an enemy's property under a neutral flag is to be respected, I do not think we shall find it so, and I think our danger is that not only our own coaling stations, such as those at the Cape and Simon's Bay, but also those at St. Vincent, Madeira, and other places which are on neutral soil will not be safe, and I think with our chronic want of foresight, a man-of-war might-very easily, in the early weeks or even months of a war, make a raid

upon these coaling stations, set them on fire, and give us a blow from which we shall take many months to recover. I entirely endorse what Captain Bridge says about the hydraulic propellers. I think they have never been done justice to. I do not think the cause of its not having had more success is the question of economy. I thought the great drawback was, that it failed to give the speed other propellers had.

Captain BRIDGE: I mean economy in power.

Admiral Sir F. NICOLSON: You have alluded to the Declaration of Paris; what I am going to say will rather support your views. I do not know whether you remembered when you alluded to the Declaration not having been considered by the Confederates and Federals, that the United States never agreed to the Declaration at all: neither did Spain. So that we have a large maritime nation like the United States, where plenty of privateers might be equipped, not agreeing to the Declaration by which it was intended that privateering should be abolished.

The CHAIRMAN: I quite understand that, but I think it carries very little weight after all. I am quite aware the United States repudiate it, but if they could repudiate it so could we, and so will any country whenever they think it proper and convenient to do so.

Captain BRIDGE: When I made use of the phrase "enormous superiority of "force," I meant for the express purpose of keeping the enemy's war fleet in his fortress behind his guns. I only used the American illustration as the best that there was, although a bad one.

Captain LONG: I quite agree with our Chairman in all that he has said about the Declaration of Paris; I do not believe in paper, but in the Navy. As a matter of fact, the Declaration of Paris was jointly executed by all nations excepting the United States, Spain, and Mexico, but the United States have since practically assented to every part of it except with regard to privateers. With regard to the number of vessels in reserve, of course I cannot pretend to lay down any exact rule. I quite agree with Captain Bridge that a great superiority of force will be required. Captain Bridge has just mentioned his lecture[1] which I had the advantage of reading, and also some other papers which he was kind enough to send me, from which I derived considerable benefit. I think his lecture a very valuable one; I am only sorry it was not delivered in this Institution, when we should have heard more of it. It is not only a matter of supply; there is also the question of refitting, the question of keeping the bottoms of ships clean. Then there is the liability to damage, and damage with a ship in nine cases out of ten means going into a dockyard. I do not think myself any blockade could possibly be carried on unless you have a commodious port to which to go to refit. That is one of the points I have laid down as far as I can gather from what I have read on the subject. With regard to the arc having too small a vertical extension, of course I am entirely in ignorance practically on that subject. I have simply read up all I can find about it, and I am in the same position as nine-tenths of the Officers of the Navy. The arc having a vertical extension of only 5° would I should certainly say be too small, because the boat that carried it would probably roll more than that. But that is, of course, merely a question of detail; there is no occasion to confine the vertical arc within 5°; you can make it as much as you like, subject to a consequent diminution in the intensity of the light. Of course, wherever the vessel has a light, on seeing the boat coming through the beam, she would turn her light on to it, but I do not think it would do to trust the ship's light to discover the boat. I once saw the light on board the "Hercules;" it was a hazy night, and certainly it was very far from being what I expected. As for seeing torpedo-boats I could not I am quite sure. Mr. Soutter says, taking a state of weather in which the unit of light is lost sight of at 500 metres, a light to be seen at 1,000 metres ought to have 1,600 Carcel burners, that is, 14,400 candle-power. So that if you put a light on a ship it is sure to be seen, and Captain Bridge's testimony is very important on that subject. The remark made by Captain Bridge about lighting the sights of an enemy's guns is something new to me, and is very important. With

[1] "Attack of Maritime Fortresses," read before the Royal Engineer Institute by Captain C. A. G. Bridge, R.N.

regard to the hydraulic propeller, Admiral Selwyn is going to give us a paper on that very subject; I have not, therefore, looked it up particularly. I quite agree with what our Chairman and Captain Bridge have said about it. I have often talked to naval architects on the subject, and they have said the reason the other was preferred was that it was more economical, that you get better results from your power when employed in another way than by the hydraulic propeller; and I have always replied that was not always the most important matter. I think Captain Bridge's remark about the twin screws, which my experience fully bears out, is an important one. With regard to the torpedo attacks that took place in the Black Sea, my information is derived from an article that appeared in the "North British "Review," written by Hobart Pacha. He gives an account of the attack at Batoum, and considers the failure arose from the night being very dark, and Batoum, being a little port under high land, was difficult to find. In the first place, the boats spent half the night in trying to find it, and in the next place they did not understand how to use the torpedoes, for they left the safety-pins in. I must say, reading about the attack at Batoum, and taking that in connection with what was done by such men as Cushing and Dixon in the United States, I came to the conclusion that such men as they would inevitably sink a ship with a torpedo if she was not protected. The machine-guns are certainly a great point in favour of the ship. I have every confidence in the Navy and its administration; but I think we naval Officers do well, especially in the present changing state of armaments, to meet occasionally and discuss these questions, so that our minds may be decided as to what we are going to do. We may rely upon it a country that is governed democratically will never be too ready for war beforehand, and when it comes, a great deal will be expected of us.

The CHAIRMAN: I have only now to ask the permission of the Institution, which I am sure will be given with very great pleasure, to return our best thanks to Captain Long for his very able paper.

Friday, March 11, 1881.

ADMIRAL SIR GEOFFREY T. P. HORNBY, K.C.B., President, Royal Naval College, in the Chair.

ON NAVAL TACTICS.

By Vice-Admiral DOWELL, C.B.

I FEEL that some apology is due from me for appearing before you to-day to read a paper on a subject which has been the theme of Prize Essays and treatises by Officers far more talented than myself. But I have ventured to accept the Council's invitation, having been one of those fortunate men spoken of by Admiral Randolph, who have had an opportunity of serving in our evolutionary squadrons. Twice I have held command in the Channel Squadron under Officers who rank among the first masters in the art of fleet evolutions. In virtue of experience thus obtained, I with great diffidence submit to you my views of tactics to be employed in our future naval engagements.

If in anything I say in this paper, I repeat the opinion of other Officers, I wish it to be understood that I make no claim to originality. I merely state the conclusions at which I have arrived, as the result of practical experience and study of the subject.

I propose to deal with naval tactics in connection with squadrons composed of ironclad ships, &c., occupying the place of the old ships-of-the-line. In doing this we have to consider the composition of our squadron, its armament, its organization, and the most effective method of bringing it into action, which last I propose to illustrate by a few plans of attack.

Future naval actions will differ from those of the past in being entirely independent of wind, and the fact that vessels can move in any direction will necessarily increase the value of a thorough knowledge of the signal books, and the capabilities of the squadrons and vessels composing our fleets. I have heard it said that seamen are no longer required, and that ironclads might be manned and fought by engineers, stokers, and artillerymen; so far from this being the case, I believe seamanship in the truest sense of the word is more than ever necessary. The Officer who best knows the capabilities of his ship, and has the nerve to put his knowledge into practice, is the man most likely to succeed in a naval engagement.

Our future actions will be battles of manœuvres. An Admiral will have arranged certain plans of attack (dependent on the formation of the enemy) with the view of obtaining the utmost advantage possible from his deadliest weapon, the ram. He will also be desirous of renewing the attack, after the first collision, in order of battle with those of his ships not disabled or not still engaged with an adversary. I do

not, therefore, agree with an opinion sometimes expressed that no signals will be required after the first signal to engage is dipped, or still better hauled down, when repeated. Still, however definite an Admiral's plans may be, I imagine he would find it necessary to give great freedom of action to his Captains, saying indeed to them, as Lord Nelson said to his, that no man can be wrong in laying his ship alongside—in these days in ramming—an enemy whenever an opportunity occurs.

The Composition of the Squadron.

Our ironclad Navy consists at this moment, I believe, in all of forty-seven vessels, including the "Polyphemus," the three vessels of the "Nelson" class, and all ships which have been laid down more than a year.

Of these, eleven are what may be considered serviceable broadside rams, eight of them being in commission, two of which are flagships on foreign stations; the others being ready, or those that could be got ready, for sea in a short time.

Thirteen, including the "Lord Warden," are what may be considered obsolete ships, which would not be employed in war time, while more modern vessels were available; ten of these thirteen are in commission employed in the Channel Squadron and First Reserve.

Eleven are effective turret ships, three of which are in commission, including the "Inflexible," whose Captain has been appointed; three are building, and four are, I believe, ready, or in a forward state.

Eight are turrets of the "Glatton" class, including the "Rupert," "Hotspur," "Belleisle," and "Orion," which would be considered Home defence ships, rather than seagoing ironclads.

The three frigates, "Nelson," "Northampton," and "Shannon," are formidable, and might be considered worthy of a place in the line of battle. But in view of the absence of armour from their batteries, I think they should be reserved for the purpose for which, I believe, they were built, namely, as cruizers for the protection of trade.

There remains but one vessel to be spoken of, the "Polyphemus." I believe she is not yet launched, but if she at all comes up to her designer's expectations, she will prove a most valuable auxiliary to a squadron. And it may be hoped that the day will come when every squadron will have one or two such fast handy rams and torpedo vessels attached to it.

This being the present state of our Navy, I think, seeing that in case of a war it would probably be necessary to have three separate squadrons in different places, we may consider that each squadron would not be composed of more than eight or ten ships. There would probably be a mixture of broadside ironclads and turrets. And each squadron should have at least two fast look-out vessels attached to it.

Whilst speaking of the composition of the squadron, I will add that I think it of great consequence, as Captain Fremantle, I believe, suggests, that every ship should be painted alike, with a distinctive mark, such as a white streak, or some other badge, to distinguish our ships from the enemy. Also that the mastheads of all vessels

should be painted alike, with a distinctive mark besides the vane ordered to be carried. A waterline, visible as the smoke lifted, would also be an advantage. Black and white appear to be the best colours.

The Armament of our Squadrons.

In considering the armament, we have the ram, the gun, and the torpedo to fight with. In point of effectiveness, I consider the ram and the gun nearly on a par, whilst (for the present, at all events) the torpedo can only be considered as an auxiliary. I place the gun and the ram so much on an equality because of the range of the gun, and its capability of being trained. No enemy can escape a well-directed broadside, whereas it is possible, by the use of the helm, by increasing or decreasing speed, to avoid the ram, though this, when it takes effect, is the deadlier weapon of the two. In the use of the ram every Officer should know the turning power of his ship, the diameter of her circle at different speeds, and her time of turning. But in action it will be impossible, not knowing the enemy's speed, to judge exactly where he will be when the ship has turned eight points. The endeavour should be, therefore, to give the ship sufficient room to turn to deliver the ram with the helm eased, so to speak, to steer into the enemy. Most modern ships, even without steam-steering gear, will turn eight points in 300 yards. I would, therefore, lay down a rule that one and a-half cable should be the distance allowed if possible; that is, supposing the ship to be rammed is one mile ahead, I should bring her to bear three-quarters of a point on the bow. Here it is that a seaman's eye will come in. A ship can only effectually be rammed, except it is by chance, by steering for the ship herself, for it must be remembered that the enemy has command of helm and steam as well as ourselves, and even if he cannot increase his speed, he can always slacken it, or stop, or turn to avoid being rammed. He will, moreover, have studied tactics as well as ourselves, and probably, simultaneously with our manœuvre to attack, will be his for the same purpose. In naval actions now almost more than ever, will the balance of advantage tend in favour of the party who can deliver the first blow.

With regard to the guns of the present day, though they have a range of two or three miles, and though in the contest between guns and armour the gun has decidedly had the advantage, yet we must remember that their effectiveness is limited by the armour they have to pierce, and the angle at which they must therefore strike. Fire should be reserved, except on special occasions, until the distance is less than 1,000 yards, and the bearing as nearly as possible at right angles to, or on a line with, the adversary's keel. Of course, cases may occur, such as an enemy attempting to escape, when bow fire would be of use at greater distances to damage, if possible, his steering gear; but such, I think, need not be considered here.

Whilst speaking of the use of guns, it is also necessary to consider the mode of firing them. All ships are now fitted with electricity, one of the most valuable inventions of modern times, provided, so it

appears to me, it is confined to its proper use. I should say that electric firing should be used at all times when a broadside is required to be delivered at ships rapidly passing, or when the ship is herself turning. In this case the Officer at the director, being able to see all round, can watch a vessel and be prepared to press the firing key the moment she is on with the points of the sights, whereas the Officer in the battery and the captain of the guns will only see her a few seconds before she is in the line of fire. Thus, in a ship failing to ram and passing astern of her adversary, the Officer at the director would be in a position to fire at the effective moment. When, however, the object to be fired at is not rapidly altering its bearing, I think it would be a grave error to allow the Officer at the director to assume the functions of the Officers in the battery and the captains of the guns.

An opinion has been expressed that the points of the director should be brought to bear by moving the helm. A very serious mistake this seems to me. Where would be the limits to which the ship's head might be turned? and what would be the position of a squadron at the end of a few minutes of such work?

With respect to torpedoes, we have to consider two descriptions of these weapons—the Whitehead and outrigger torpedoes. The Whitehead torpedo is a very formidable weapon, and must constitute in future a considerable factor in naval engagements. But, from what I have seen of the practice with these weapons, I should be inclined to limit the distance at which they should be fired to 400 yards.

It is only within the last year or two that the use of outrigger torpedoes has been considered available for large ships, and never having seen the experiments tried, I feel that my opinion on the matter will have little weight. I confess that this weapon does not commend itself to my judgment. The idea of a ship going into action with her lower booms in the air, and a big charge at the end of each, to be lowered for use, on passing close to the enemy, is not prepossessing. It must be remembered that when lowered there will be at least 18 feet of boom with its bulky charge at its end in the water, with a ship going eight knots! I doubt whether it will often be got into its proper position. However, I am very glad to see by a late circular that the system is to have a fair trial. But, I think, that to ensure this exercise being really effective, it will be necessary that the booms should be marked to show when they are sufficiently immersed, and that care should be taken that the charge is not exploded unless it passes at its proper depth under the target. To me, the success of the outrigger torpedo seems more than doubtful. As a weapon to be used in naval actions from ironclad ships, I fear it will never be really successful.

I have not reckoned on torpedo-boats taking any part in an engagement between ironclad ships in the open sea.

The Organization of a Squadron.

In organizing a squadron of mixed broadside and turret ironclads, I think it would be desirable to put the ships of each class in separate

divisions, though if the classes are unequally divided, there can be little reason why they should not work in the same divisions and groups.

Ships throwing the heaviest weight of metal should be the leaders of divisions and subdivisions, the same ships being group leaders. Some difficulty may arise, I fear, in this arrangement, on account of the seniority of the Captains. In our evolutionary squadrons leaders are generally and very properly selected acccording to seniority. It often happens, however, that the most powerful ships are not commanded by the senior Captains. I do not see how this is to be remedied. Captains, except in special cases, are appointed in turn, and would be unwilling to wait because the relative power of the ship vacant did not correspond with their relative seniority. Nor would it be for the benefit of the Service that Captains should be frequently changing round, to ensure the squadron being commanded by seniority from the heaviest ship downwards. But the consequence is that when an Admiral organizes his squadron for real service, it may not be in his power to make Officers leaders according to seniority, though it would of course be necessary to avoid placing an Officer in a group, where the leading ship is commanded by a junior Captain. Whatever the difficulty, I am sure that squadrons must be organized according to the power of the ships composing them.

Great difference of opinion has been expressed upon the subject of groups as to their form, utility, &c. The present Signal Book settled the form by adopting what is known as the "Channel Squadron "Group" slightly modified, it may in future be called the "Service "Group." The addition of group order to group formation greatly simplifies group manœuvring.

Captain Fremantle, in his valuable essay, expresses an opinion that groups are useful for evolutionary purposes, but are not a formation adapted for order of battle. In this I differ from him very decidedly. For evolutionary purposes we have divisions and subdivisions in any number the Admiral may think desirable. Groups for this purpose would be an unnecessary addition to the signal books, whilst I consider them to be the formation most applicable for order of battle; and for these reasons:—Group order affords the Admiral the most rapid method of altering his formation, as it takes but a couple of minutes to change from group order to group formation; in groups ships obtain the greatest freedom to use their guns and rams without injury to their friends; groups give them the fullest power of combined and independent movement and mutual support; and in groups, three ships can conveniently attack two—a desideratum in naval warfare. There is an advantage also in the irregularity of this formation, an enemy will be less able to judge of the position of our ships and consequently be less able to attack successfully.

Naval tactics can hardly be discussed without an allusion being made to the signal books. It is manifestly imperative that every Officer should possess a thorough and practical knowledge of them. But I do not consider it my duty to criticize them even if I felt competent to do so. They have lately been revised by a very efficient

Committee of Officers, and I gladly take this opportunity of adding my tribute of respect to the memory of the gallant Officer who was the Chairman of that Committee.

With his ships in close order an Admiral has the power of moving his squadron in any direction at a moment's warning. I consider that close order is the best at all times for the individual safety of the squadron, though at night, or in crowded waters, or in heavy weather, it is desirable to put the ships in open order that they may have more room to sheer to avoid merchant vessels.

Here, perhaps, I may be permitted to remark on the absolute necessity of station-keeping, addressing myself to the younger members of our profession. The efficiency, if not the safety of a squadron, depends on its units being in station. With the ships in station the squadron is a machine, which can be moved at once in any direction required with perfect safety; with the ships out of station, it is an irregular mass, which an Admiral would be unable to move for fear of accidents. Whatever excuse there may have been in former days when ships were dependent on wind, and when an alteration in the ship's trim might throw out the calculations of the Officer of the watch, there can be none now in our ironclad squadrons; they always have command of steam, and a few extra revolutions will preserve station at all times.

It is customary for the Admiral to make the signal at what rate of speed he intends to proceed, but it must be remembered that this speed is merely given as a guide. All ships other than the flagship should have command of a knot at least more speed than is ordered. As a rule in large ships it is advisable to have one boiler more than the number of revolutions absolutely required; this is economical, as it avoids the necessity of pressing the fires when an increase of speed is necessary. Of course when there is any prospect of meeting an enemy's squadron, all ships will be prepared to use full power, though I agree with Admiral Randolph in considering the speed most advantageous for engaging an enemy would be from 7 to 8 knots. This allows a sufficient margin for increasing or decreasing speed as may be necessary to effect or avoid a ram; it is fast enough to obtain the best results from the helm, and it gives more time to mature the plan of attack than a higher speed would allow.

But I decidedly think that in all plans of attack the ships should turn the same way to ram. It appears to me there would be considerable risk to our own squadron, if the ships of each division attacked in opposite directions, however carefully a plan was arranged to avoid it.

Where the question is open, an advantage would be gained by attacking to leeward, in order to avoid the smoke that hangs so long to leeward of a ship, and would obscure one's own vision rather than that of the enemy.

I quite agree again with Admiral Randolph that it is our duty to capture if possible, not to destroy; but I doubt if boarding will be a feature in naval actions of the present day, certainly not after ramming. A ship having effected a successful ram will go astern at full speed im-

mediately to disengage herself, and to be prepared to evade any other of the enemy's ships which may attempt to take advantage of her stationary position.

In future naval actions some ships are certain to be sunk, and I think it should be an understood thing how far we are prepared to take measures to save life. I have said before that I consider every squadron should have a couple of fast unarmoured frigates or corvettes attached to it, and my suggestion would be that these ships, taking no active part in the engagement, should be prepared to assist any of our own vessels which might be disabled, and to save the crews of any enemy which might be sunk. I believe in the great naval battles at the beginning of the century it was an understood thing that frigates were not molested in such work, unless they in any way joined in the action. Such I think should still be the etiquette in the present day. Battles now will be fought at such a speed that any vessel disabled will soon be left behind, and there would, therefore, be no temptation to disturb the frigates in their endeavours to save life.

Preface to the "Attacks."

An Admiral will probably have arranged at least eight plans of attack, to be used according to the formation in which he finds the enemy. I content myself with proposing four, namely: for an enemy in single column, line ahead; in single column, line abreast; in pelotons (or equilateral groups), line ahead; and in pelotons abreast.

I will begin by saying that I do not for a moment imagine that an enemy would allow me to make these attacks without performing evolutions to frustrate or avoid them, and probably to retaliate. Nevertheless, even with the certainty that the plan will not be carried out in its entirety, I hold that a settled plan is necessary for every formation in which the enemy may be found, and that our squadrons must act on the offensive, not defensive.

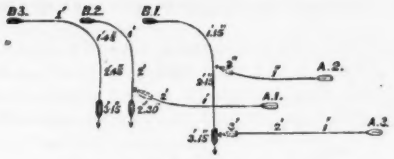
I have, before entering on these four attacks, drawn out a few figures, in which I have allowed the enemy to be the attacking party, for the purpose of exemplifying one of my reasons for adopting the group formation, namely, that I consider it the best adapted for resisting any counter-attack that the enemy may bring against me.

In these figures I have made no attempt to move my ships until the enemy has moved a minute. I call my own ships A, and those of the enemy B. A's object is to ram B, and B's to ram A; but their mutual endeavour is to avoid a direct collision stem to stem. The speed in all my diagrams is supposed to be about eight knots.

In Fig. 1, the enemy being in line ahead, on his starboard bow, A's ships are in starboard group formation. B decides to ram A2 with B1, and to throw B's 2 and 3 on A1. I have placed the nearest ship of my squadron one and a-half cable from B's line. It takes B1 after his helm is moved about two minutes to reach A2, and B's 2 and 3 two minutes and thirty seconds to reach A1, whilst they require thirty seconds more to reach A3.

A's movements, therefore, are as follows:—A2, when he sees B1 is turning, can avoid being rammed by putting his helm to port, and

FIG. 1.

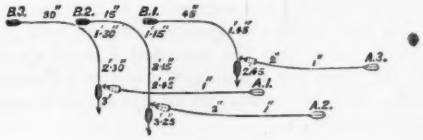


Scale $\frac{1}{8}$ of an inch = 1 cable.

possibly by an increase of speed may succeed in ramming him on the quarter; if not, he will pass astern. While B1, if he continues his course, will just meet A3, who by decreasing his speed will be in a position to ram him.

B's 2 and 3 will have to put their helms over within forty-five seconds of each other, and A1 will have a minute and a-half to prepare for them. If A1 goes full speed he will pass ahead of B2, and will be in a position to steer into B3; but he would probably, by putting his helm to port, endeavour to ram B2.

FIG. 2.



In Fig. 2, A's group is in port formation.

B decides to ram all A's ships. It will take B1 two minutes to reach A3, B2 three minutes to reach A2, and B3 two minutes and thirty seconds to reach A1, after their helms are put over. A3, when B1 has had his helm over a minute, can, by putting his helm to port, avoid B1, but, by increasing speed and steering at B1, he will probably ram him on the quarter, or, if not, pass astern.

B2, in attempting to ram A2, will have given him two minutes' notice, by taking advantage of which, by increasing his speed and porting his helm, A2 will be in a position to ram him.

A1 by putting his helm hard to port and increasing his speed, may ram B3, if not, he will pass astern of him. N.B.—I should, when the enemy are on the starboard side, adopt the starboard group formation, and *vice versâ*.

FIG. 3.

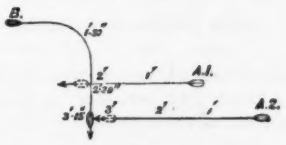
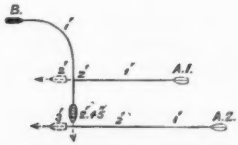


Fig. 3 is a small diagram I have drawn out, to show the superiority of quarter line at five and a-half points (60°) to quarter line of four points.

As 1 and 2 are two ships in quarter line of 60° at two cables, B at one and a-half cable on the starboard bow steers to ram A1. If he misses her, in forty-five seconds he is just ahead of A2, and a very little increase of speed on her part will effect a satisfactory ram.

FIG. 4.



In Fig 4 the ships are in the same order, but A2 is at four points. B attempts to ram A1; he just misses her; but finding A2 directly ahead of him, he would in all probability, by helm and increase of speed, ram him.

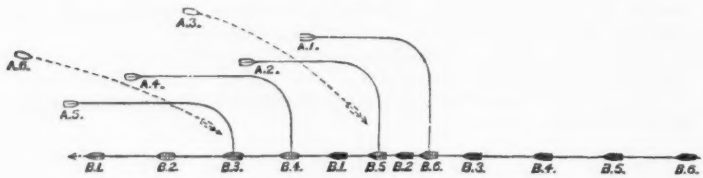
I think this shows that in quarter line at 60° No. 2 is a much better support to his leader than in quarter line at four points. For this reason I should never use the indented line or quarter line of four points; and, in attacking equilateral groups, I should not attempt to ram the leader. Also in the service groups I should prefer No. 3 should be four cables from No. 1.

Case 1.

I begin now to describe my four cases of attack.

In Case 1, A's squadron of six ships sights an enemy's squadron B, also of six ships, at four miles distant, in single column line ahead, steering a nearly opposite course.

CASE 1.



Scale $\frac{1}{2}$ of an inch = 1 cable.

A's Admiral decides to attack in columns of groups in quarter line; attacking B on the starboard or port side, as from the position of the squadrons he thinks most advantageous.

I presume the attack to be on the starboard side. A's Admiral makes the signal for starboard group formation; No. 2 group forming in quarter line, A4 being seven points abaft A1 at five cables.

A steers a course so that A5 should pass one and a-half cable on B's starboard beam. If B continues his course, A1 will pass B1 at a little over three cables. On arriving at this position A1 fires his electric broadside at B1, and, reloading, is ready to fire his second at B3 a minute and a-half afterwards. A1 then puts his helm to port, and steers to ram the last of B's ships, that is B6.

A2 reserves his broadside for B2, firing it by electricity when abeam, putting his helm over and steering to ram B5.

A3, firing her electric broadside at B1 when her guns will bear, steers a lasking course so as to come up astern of A2, ready to ram B's 5 or 6, if either are missed.

A's second group continues its course until A4 can fire an electric broadside abeam into B1. A4 then puts his helm over to ram B4.

A5 puts his helm over to ram B3, firing an electric broadside at B1, when his guns will bear; while A6 steers a lasking course to come up astern of A5 ready to ram B4 if A4 misses, firing a broadside at B1 when his guns will bear.

All A's ships fire their bow guns before ramming, and those who fail to ram discharge their electric broadsides and torpedoes into the stern of their opponents and proceed about four cables, then turn eight points to starboard and re-form groups. It must, however, be remembered that sight being absolutely necessary to effect a ram, bow guns should not be fired until the ram is safe.

When the order is given to prepare to ram, guns should be laid abeam with extreme depression to discharge a broadside into the adversary's stern, if the ram fails.

The question now is, what B's Admiral would do to resist the attack?

B might steer so as to pass through A's line between the groups. In this case A's first group would be turning inwards, and so might take B's leading ships on the flank; whilst A's second group would not have turned, and probably A's 5 and 6 might have a chance of ramming B's ships to port.

Supposing that B elects to turn, so that B's 1 and 2 should ram A's 4 and 5, B's ships will have to continue their course until B1 is within two minutes of A5, and B2 within two minutes and thirty seconds of A4.

Before they can reach them, these ships will already have put their helms to port, and the case becomes exactly what is depicted in Fig. 1.

B's 3 and 4, if intended to ram A's 1 and 2, will have to put their helms over about a minute before A's 1 and 2 will have put theirs over to ram B's 5 and 6. These ships will therefore pass each other unless the A's, by a rapid alteration of their helms to starboard, may catch the Bs' sterns, whilst A3 will be on the watch for B3 when the latter has missed A2.

If B's 5 and 6 have continued their course, a ram may still be effected by A's 1 and 2. But if the B's have turned to starboard, A's

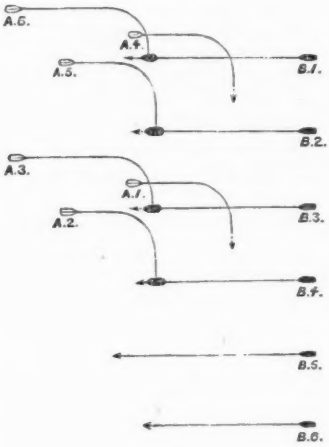
ships, by giving starboard helm, will bring their broadsides to bear on their sterns.

I will here state that my plan of attack would be the same if the squadrons consisted of double the number of ships formed in two columns of divisions in line ahead. My formation would be in columns of divisions of groups in échelon, as before, the distance between the columns being regulated by the distance between the enemy's divisions, the leader of A's second division being six points abaft the beam of the leader of the first division.

Case 2.

The enemy's squadron is observed to be in single column line abreast. A's Admiral makes the signal—"Form groups to starboard, "column of groups abreast, leaders four cables apart." A1 steers to pass half a cable on B3's starboard beam, and A4 the same distance on B1's starboard helm.

CASE 2.



When about three cables from the enemy the signal to engage is dipped.

A1 delivers her electric broadside and torpedoes on passing between B's 2 and 3, and A4 one broadside on passing B1, their guns being trained 5° forward, at the same time they put their helms aport to pass astern.

When B's 2 and 4 bear two points about five cables on the bow of A's 2 and 5, the latter fire their bow guns at B's 1 and 3, immediately put their helms over, and steer to ram B's 2 and 4, firing

their port broadsides also at B's 1 and 3 as these bear abeam, their starboard broadsides and torpedoes being ready to pour into the stern of their adversaries in case they fail to ram.

When B's 1 and 3 bear one point about four cables on the bows of A's 3 and 6, these ships put their helms over to ram B's 1 and 3, A3 firing her bow guns, when she puts her helm over, at B2, and her broadside when she bears abeam; and, of course, like their consorts, being ready to fire into the sterns of their adversaries, if they miss their ram.

In this case A's leaders, having at first continued their course unchanged, would probably have deceived B's Admiral as to A's intention of ramming.

It is difficult to decide what B's evolution would be to frustrate A's attack; but whatever his movement, A would be prepared to counteract it.

If B's Admiral decides not to continue his course, but to endeavour to ram A's ships, his own ships, being in line abreast, must all move simultaneously.

Supposing he turns to starboard, intending to ram A's leaders, he would have to alter course before A's 2 and 5 had moved their helms; these would, therefore, continue their course a little further. A's 1 and 4 would at once put their helms over to avoid being rammed by B's 1 and 3. A's 3 and 6, increasing their speed, would steer to ram B's 1 and 3, while A's 2 and 5 would have a chance of ramming B's 2 and 4.

If, on the other hand, B's squadron decides to turn to port, A's groups, by increase of speed, would probably succeed in ramming, as originally intended. They would certainly not themselves be rammed.

Case 3.

The enemy's squadron of six ships is observed to be in column of equilateral groups (pelotons) line ahead.

A's Admiral decides to attack on B's starboard side in the same formation as if B's squadron was in single column line ahead, namely, starboard group formation, the second group to be seven points abaft the beam of the leading group at five cables.

A steers so that his nearest ship may pass half a cable on the beam of B's starboard wing ship, intending to ram B's 5 and 6 with A's 1 and 2, and B's 2 and 3 with A's 4 and 5.

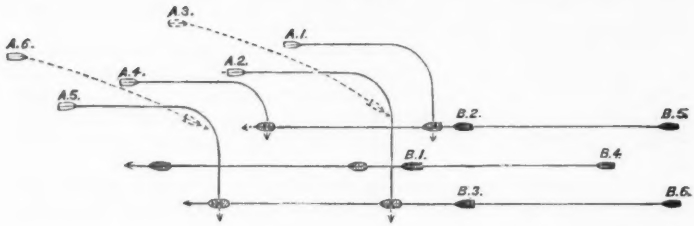
A1 fires his starboard broadside at B1 when abeam, and another at B2, a minute and a-half afterwards, as his guns bear after his helm has been put over to steer to ram B5.

A2 fires a broadside and torpedo at B1, and also another at B4 when his guns will bear as he passes to ram B6.

A3 steers to come up astern of A2, to assist either her or A1. She fires broadsides at B's 1 and 4 when her guns will bear, and endeavours to ram B5 if A1 misses.

A4 continues her course until it is time to turn to ram B2; and A5, the same to ram B3, firing at B1 as she passes.

CASE 3.



A6 steers to come up astern of A5, to assist her or A4. She fires a broadside at B1 when her guns will bear, and endeavours to ram B2 if A4 misses. All ships fire their bow guns before ramming, and have their broadsides and torpedoes ready in case they miss their ram, to pour into their adversaries' sterns.

B's first movement would probably be to close up his rear group so that B4 should be two cables from B's 2 and 3. This would hasten the movements of A's leading group, and save B's 1 and 2 from two direct broadsides.

B4 would then be in a position to ram A4 if this ship missed B2; but A4's helm would probably be hard to port in his endeavour to ram B2, and by keeping his helm over and going full speed he would still pass ahead of B4.

If, however, A4 saw the position in time, he might give up his attempt on B2, and by starboarding his helm, steer to ram B4, supposing A2 had succeeded in ramming B6. If he had not, A4 by passing astern of B4 might succeed in ramming B6.

If again B decided to steer to break through A's groups, he would hardly from his formation succeed in ramming any of A's ships; but A's rear ships might be able without injury to their friends to effect a ram on the rear ships of B.

Case 4.

The enemy is observed to be in pelotons, line abreast, steering towards A's squadron.

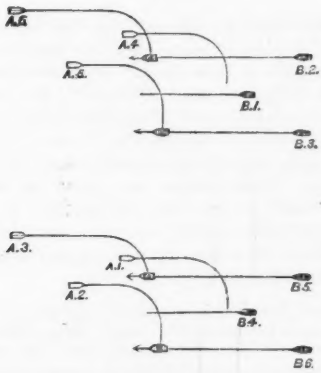
A's squadron in group formation, column of groups abreast, steers so that its leaders of groups shall pass half a cable abeam of B's 2 and 5.

A's 1 and 4 fire an electric broadside 10° forward at B's 1 and 4, putting their helms over at the same moment to pass astern of B's 2 and 5, firing their torpedoes at these ships when abeam, and a second broadside as they pass their sterns.

A's 2 and 5 fire their bow guns at B's 2 and 5, putting their helms over to pass close under the sterns of B's 1 and 4, when these bear one point on their bow at three cables. They fire their port broadsides by electricity into B's 2 and 5 when their guns will bear, and

their starboard broadsides into the starboard quarters of B's 1 and 4, reloading immediately to be ready to ram B's 3 and 6.

CASE 4.



A's 3 and 6 continue their course until B's 2 and 5 bear about a point on their bow at four cables. They then put their helms over to ram these ships, A3 firing her port broadside at B3 when her guns will bear.

In this case B's 1 and 4 might endeavour to ram A's 1 and 4, but to do so they must cross the bows of B's 2 and 5, and risk being rammed by A's 2 and 5, and also by A's 3 and 6 if they miss A's 1 and 4.

B's 2 and 5 can hardly ram A's 1 and 4, to do so the four ships would put their helms over together, and the result would be that they would graze past on their starboard sides.

From the position of B's 3 and 6, their ramming would be out of the question, and even firing from them would be doubtful.

B's groups might turn together to break through A's groups, but they would still run the risk of getting one ram at least from A's rear ships.

Conclusion.

I will conclude by observing that the immense importance of exercising squadrons can only be fully realized by men who have served in them. To make a squadron thoroughly efficient the Admiral must have confidence in his Captains, the Captains in each other, and the Lieutenants in their brother Officers. It has been my good fortune to serve in squadrons where this spirit of *camaraderie* existed to perfection. I remember once going into a narrow harbour where some of the rear ships had to pass the headmost ones after these had let go their second anchors. I had to pass close under the stern of one. Her Captain said to me afterwards, "You were very close! You would

"not have cleared me if I had come astern." "But," I said directly, "I knew I was quite safe that you would not!"

So it should be with all Officers in a squadron. The Officers of the watches know well their opposite numbers. If there is a bad Officer of the watch, it is known by many in the squadron besides his own Captain.

Of course it is true that we cannot keep up the same squadrons in peace that we should want in war. But we can do, and I am happy to say are doing, something towards it. We have now three squadrons, the Mediterranean, Channel, and Detached, the last two of which should always consist, I think, of at least six ships each.

I believe that no portion of the country's money is put out to better interest than that spent in training naval Officers and men to fight our ironclad squadrons. Large sums are spent on coast and harbour defence, no doubt wisely spent; but our position as a nation will be lost when the safety of the country depends upon those defences. Our true defence lies in our ironclad squadrons, and every sacrifice should be made to keep these thoroughly efficient.

Admiral RANDOLPH, C.B.: It is impossible to enter into this subject, or to follow the gallant Officer through his admirable lecture, with anything like detail. It is too complicated a question to deal with offhand, but I am quite certain that the lecture to which we have just listened will form a very interesting and instructive study for our leisure hours. On approaching the subject, at first sight we meet with a difficulty of this description, that to lay down any system of tactics, it seems to be necessary first of all to know the character and power of the force which will be at your disposal, and it is utterly impossible for any Officer at the present day to foresee what will be the composition of that fleet, or any squadron of that fleet, which will be sent to sea at the approach or the breaking out of war, to represent the majesty and might of England. It will not be a fleet of "Minotaurs," nor of "Monitors," it will not be a fleet of "Dreadnoughts," neither will it be a fleet composed entirely of "Inflexibles," of "Nelsons," or of "Téméraires." One and only one thing seems to be quite certain,—it will not be a homogeneous fleet, it will be excessively heterogeneous, and the ships that are superior in speed and power will be compelled to tone themselves down to the level of the inferior ships; and it is almost impossible to construct a system of tactics which shall develop the best powers of the ships, individually or collectively. In military affairs we are quite aware that the great improvement in arms of precision has necessitated a change in tactics. The military are perfectly acquainted with the powers of their weapons, but we, on the other hand, are not so favourably situated. When any invention is introduced with regard to guns or rifles, it is subjected to the most exhaustive series of trials, and then to the adjudication of competent Committees, composed of the most experienced and practical Officers, and their opinions decide upon it. With us, on the contrary, it is different. So far as the ordnance are concerned, we are on the same footing, but when we come to what is not in the least bit less important, the question of gun-carriages, that is, the ships to carry them, it is totally different. They are not subjected to the same criticism, to the same examination or experiment, or to the same sort of tribunals to decide upon them. In what I am going to say I emphatically repudiate any desire to make the slightest reflection on the authorities at Whitehall, and still less upon that excellent and most efficient Board of Construction, than which I do not believe a better or more efficient Board exists in any country. But I do not think that they can be fairly held responsible for the vessels which they produce. It is hardly too much to say that some of them are produced and built in spite of them, the "Captain" for example, and the designs, before they are adopted, do not seem to be subjected to professional criticism, or founded always upon a distinct and proper principle. Take for instance the case of the "Inflexible." I believe the "Inflexible" is designed upon

the principle of carrying the heaviest artillery beneath the cover of the heaviest armour, but I do not think it was apprehended what specific object or duty that ship was to carry out when she had accomplished this. What is the specific duty which that ship is able to carry out, as well as or better than two other ships of half her size? Is she considered the most efficient ship to attack one of her sister monsters? Will she conduct that attack more efficiently than two ships of half the size, carrying together the same armament? Is she considered to be more efficient, say to force the passage of the Dardanelles—a question which I think our gallant Chairman is able to answer better than anybody else—is she considered more effective to effect the passage of the Dardanelles than two other ships would be carrying equal armament? I understand you may say yes, because of her invulnerable armour, but to that question I will refer by-and-bye. What I ask further is, is she as a unit of a seagoing fleet likely to be more efficient than two other vessels which I will call two subdivisions of herself, carrying conjointly the same artillery? or is she more efficient as a ram than those two vessels would be together? Undoubtedly 11,000 tons will convey a very much heavier shock than 6,000, but I apprehend that even ships of 6,000 tons will do all that is necessary in that respect; and if that be so, the rest is just so much superfluous waste of power. Then what are the objections to that ship? It has its disadvantages. First of all there is the question of cost, which I believe cannot be a farthing under three quarters of a million. I would not complain of the cost, if we had value received, but at that cost is she not just as liable to destruction by a torpedo as a vessel one-fourth her size? Is not her draught of water sufficient to exclude her from shallow seas, where vessels of less draught could operate with safety: and does not it expose her to greater danger of getting on shore? Again, is not she, with her complicated machinery, and, I believe, as many as fifty steam-engines, rather more liable to those casualties which are incidental to the best regulated ships, as well as families? And in her case a small accident, anything going wrong with the steering gear, for instance, or any other trifling cause, throwing her out of service for even half an hour, might produce a very disastrous effect on the operations of a squadron. Then again, about her armament. There are two turrets in échelon, designed with the object of enabling her to fire all four guns right ahead and astern. I am the last person to make any objection to end-on fire but I think it is obtained at too great a cost. In her case I apprehend the fire of the sternmost turret, passing close to the foremost one, or *vice versâ*, would be very apt to interfere with the fire of that other turret. If kept up continuously, firing over the deck would soon shake the deck to a serious extent. But if she has the advantage of a superior end-on fire, look at what a sacrifice it is of bow and quarter fire! I think it will be found, from the size of her turrets, and their close position to each other, that including the funnels, they obstruct each other to at least 55° or 60°, just one-third round the compass. Then of course the smoke of one will interfere very much with the firing of the other. Besides that, if a ship has turrets in line with the keel, and is exposed to end-on fire, one protects the other, but instead of protecting each other these turrets are a source of mutual danger. They are so placed as to reflect the shot upon each other, so that the same shot may strike both. The same thing applies to fire from a little abaft the beam on one side, or a little before on the other. With respect to her armament, I have very great belief in the efficacy of shell-fire, even small shells bursting over the uncovered tops of open turrets, which are common in foreign navies, or guns *en barbette*, or the hide-and-seek guns of the "Téméraire," or in the unprotected batteries of the "Nelson" and Northampton class. The broadside of the "Alexandra" would probably fire three rounds to two of the "Inflexible," that is, eighteen shot to eight. I think that is a very important consideration. What then is the ship adapted for? Is she a ship that you would select to blockade the Baltic, or any other shallow seas bristling with torpedoes? Is she particularly adapted to bombard batteries, or for blockading the coast of America? Or is she the ship that you choose as the unit of the sea-going fleet? If not, I submit this is a vital question. The way to look at it seems to be this: First consider what are the objects that you will have in view in the event of another war breaking out. So far as it is possible to foresee them, they will be not singular but various, and the various means

by which those objects are to be accomplished must be provided accordingly. But some of them are optional: for example, it is optional whether you choose to blockade an enemy's fort or attack his batteries. Other objects may vary in importance, but there is one supreme object, one object so paramount and superior to all the others, that every other one ought to be left altogether out of consideration until this is provided for. It is one which has been alluded to by the gallant lecturer. It is one to which even the protection of our coast is secondary. That object is maintaining the freedom of the high seas. I think that object should be first considered, and all the rest will follow. The protection of your coast is hardly worth a moment's consideration in comparison. For the country must surrender at discretion under starvation if that object is not effected. The German coasts protected themselves in the last war against the French; so will ours. I think in designing our ships of war that single object has not been carried out. You should apply yourselves first to making a sea-going fleet, and I do not believe the "Inflexible" is the best class of ship for that purpose. I think such ships should be smaller, of a moderate size, of good speed, and homogeneous to a great extent, pretty nearly the same speed and manœuvring power, and built in large numbers, the more the better. When a ship is produced, I think she ought to be subjected to some sort of ordeal analogous to that which ordnance is always submitted to, as it is not a bit less important. When you have a fleet of such ships, there will be no difficulty in arranging a system of tactics which will be satisfactory, and which should be practised diligently and unremittingly. I would ask permission to return my individual thanks to Admiral Dowell for his most interesting and instructive lecture, and I would ask him to reply to two questions. In alluding to electric firing, he says, "When, however, the object to be fired at is not rapidly "altering its bearing, I think it would be a grave error to allow the Officer at the "director to assume the functions of the Officers in the battery and the captains of the "guns." The question I should like to ask is, is it possible in the *mêlée* of an action to revert backwards and forwards from one system to the other, and if so, by whose orders is it to be done? Suppose you commence with electric firing, who is to give the order when it is to cease, and *vice versâ*, when you change it to independent firing, who is to give the order when it is to be discontinued? I should also like to ask, with reference to the diagrams, whether the lecturer assumes the B's to have the same speed as the A's, and whether he allows them to have the power of reducing or increasing their speed at their discretion.

Captain GERARD NOEL, R.N.: In the presence of so many Officers who have studied and are experienced in tactics, I rise to address you with great diffidence. I take the greatest possible interest in naval tactics, and look upon the mastery of the subject in all its branches as the highest aim to which a naval Officer can aspire. We are sometimes told that we shall have no more fleet actions. We have also been told at various times that we should never again have wars, and we know to our cost how erroneous a theory this has proved. I apprehend the day will come when the fleets of England will have to fight for England's very existence, and if in those days our fleet is not in proportion to that of other nations, more powerful than it is at the present moment, we shall indeed require tactical skill on the part of our Officers. Admiral Dowell speaks of forty-seven ironclads; our neighbours across the Channel have even a greater number, some of them rather old, no doubt, but their later ships are equal in power to our own. French naval Officers study tactics, and they have a name for managing their ships with great skill. I do not mean to say that our Officers are less skilful, but I think, comparing the two nations as naval Powers, we have considerably less practice in manœuvring. In our bulldog obstinacy and pride, we are apt to neglect practice, and it is this that will very likely bring upon us reverses. So much in favour of the importance of naval tactics. Now I should like to make a few remarks on the paper we have heard read. I am sure we must agree that Admiral Dowell's advice upon the subjects of keeping station, his opinion as to the use of the boom torpedoes, the importance of signals, the best speed at which to go into action, the selection of group leaders, his high appreciation of the group system, of the ram as the weapon upon which to base a plan of attack, and his humane remarks on the help to be afforded to the sinking, are of the greatest value and interest. I am delighted to hear Admiral Dowell

support the system of groups. I think if fleets go into action, it will be found that the group system is the one of all others the most to be depended on, and in a small fleet, say, under ten ships, if you bring your fleet into action "in single column of "groups in line ahead," I think you will have the advantage of every formation that the enemy can bring against you. (Of course, if you had a larger number of ships, the circumstances would be different.) If your fleet is in such good manœuvring order, that you can approach the enemy showing a broad front, and at the last moment bring your groups into single column line ahead, and double on your enemy, so much the better; but you must be in really good manœuvring order, and have full confidence in your Captains; then at the last moment the group that is told off to lead, will lead, and the others will follow in its wake, and in that way you deliver all your broadsides, all your torpedoes, and you have the advantage of the enemy. There is one point in which, perhaps, I may be allowed to differ from the gallant lecturer, on the question of ramming. He says A and B should mutually endeavour to ram, and yet to avoid direct collision, stem to stem. I am strongly of opinion that if you determine to ram the enemy, you must at the same time make up your mind to meet him bow to bow, if he is equally determined to ram. If he flinches, then you go into him; if you flinch, then he ought to go into you; I think there is no way out of it. I do not apprehend for a moment that two vessels well built, meeting bow to bow, would do more harm than rub each other's sides well down; and I may here remark, that I look forward with dread to the day when the strong advocates of breech-loading and *long* guns place such guns in our ships that they cannot be run in clear of the ship's side, for we shall have them all dismounted, one after the other; it would be a very serious thing if we ever put guns into a ship that could not be run in clear of the ship's side. I do not think there is any other safe way of ramming. If you attempt to turn and ram, or ram from abeam, you find yourself in the position that Captain Colomb has often spoken of here, of it being merely a matter of 50 yards, whether A rams B, or B rams A. I think that if you intend to ram, you must, when close to him, keep your bow on to the enemy. As regards groups in the matter of ramming, if they are opposed to line ahead, I take it the leading ships would rub, the supports would ram, and that is where the group has the advantage of the line ahead. If it was not for that, I think the single line ahead is the strongest of all formations, but in the matter of ramming, the leader of the line ahead, being disabled, would upset the whole line. There is another question about groups, which I mentioned on a former occasion, when we discussed Captain Fremantle's essay. It is that of turning. What Admiral Dowell called the "service group," is a group where the rear ships are nearer the wake of the leading ship than we have had in former groups, and I think that carries with it a great advantage. Again, I must say that I entirely agree with Admiral Dowell about the rear ship; I think a constant distance of 4 cables is the best position of the rear ship, especially as Nos. 2 and 3 ships of a group are now nearer the wake of No. 1. On the question of turning, I mentioned a suggestion that it would be best, if you required the groups to turn more than a certain number of points, that 2 and 3 should come into the wake of 1, and I proposed that directly the signal is made to turn, they should do so without any further signal, and that, when the new course has been attained, they should re-form in group. Since that time, Admiral Hood has tried the turning of groups by bringing the other vessels into the wake of No. 1 by signal, and he then turned and re-formed the group by signal; and I believe he saved seven minutes in turning through sixteen points, and re-forming the group. As to torpedoes, I think so far as they are fired from ships, we must as yet ignore them in a fleet action. Whether we shall be able to ignore them after the first severe battle, I do not know, but at present I think we have not had sufficient proof of their value to be able to give them a prominent position. On the other hand, if torpedo-boats are brought into action, they will very much influence, and perhaps alter tactics. The swift boats which our present ironclads carry, and which no doubt will be lowered into the water before the action, and kept steaming alongside their respective vessels, to be shot out ahead before the ships themselves engage, will very much disturb the enemy, or very much disturb us if we have to act against them. Admiral Randolph spoke rather about ships than about tactics; there is no doubt it is very necessary in

tactics that we should know what ships we have to fight with before we can arrange how we are to fight them. I should like to see three recognized types of vessel: one for coast defence and attack, such as the "Dreadnought," and smaller mastless vessels of that class. Then another class of ironclad cruizers, of which the "Nelson" is a very fine type. Perhaps she might have her armour a little higher, as high as the port sills, and do away with the armoured deck. Then the third class should be ordinary cruizers; the last two classes heavily masted. Here we must bring in seamanship. Seamanship in the present day I hold is more important than ever it was. Our fleets must keep the sea. Our fleets cannot keep the sea under steam only, but what they will have to do is this, they will have to be under sail the greater portion of the time, and when they sight the enemy, they will have to dowse the sail smarter than they have ever done it yet, in order to catch him. I think the great basis of our system of regulating the masting of ships should be with a view to reducing everything that offers resistance to the wind as quickly as possible, so that our vessels from being under sail can be prepared for steaming head to wind in the shortest conceivable time. A well-known Captain was very fond of bugle sounds, and his signal for getting up steam, down screw, and shortening sail was "Polly put the kettle on." I should like to see that "Polly put the kettle on" brought to perfection. In conclusion, I think the Institution, indeed the whole Service, owes thanks to Admiral Dowell for so ably bringing this subject under discussion, and if I may be allowed to say so, I am sure every one will be delighted when they hear, or, if they are present, when they see, Admiral Hornby in the chair.

Lieutenant BETHELL, R.N.: I do not presume to rise in any spirit of criticism with regard to the interesting lecture which we have heard, but nevertheless there is a question about which I wish to ask for information, and that is, as to the speed of vessels or fleets in going into action. I would ask Admiral Dowell, supposing one of those ships (conditions on diagrams) chooses to increases its speed to 12 or 14 knots, what must be the result? Would his enemy let him come at him at that speed whilst he was only going at 8 knots? It seems to me that the enemy, on seeing an increase of speed, will himself increase his speed, that is to say, one vessel has the power of forcing the speed of its adversary. Another observation I should like to make is with reference to the idea that ramming, on the whole, is objectionable, in so far that our object ought to be to capture and not to destroy. I do not for a moment propose to argue that as a metaphysical point, but it seems to me that it is our duty in war rather to destroy a whole shipload of our enemy than to risk the life of one of our own men; and if this destruction is most quickly effected by ramming our enemy, it should be done as soon as possible. There is a subject which has been only touched upon, and that is signalling. I know it has been held that on the signal for action being hauled down, there would probably be no further necessity for signalling during the action; but I am told that that idea is going out, and it seems it must be so, for as we improve in our power of moving these great masses about at high speeds, it will give enormous power to the commander of a squadron to be able to signal with great rapidity what he wishes. That being so, I will just point out how ineffective the present system of signalling is for this purpose. Orders are required to be conveyed to Captains in the least possible time, and if it were possible to have the telegraph for that purpose it would not be too quick. On the contrary, what have we? We have a system of flags, and we know how slow flag-signalling is; and not only that, but when the flags are up they are difficult to distinguish, and to manœuvre them a great number of men are required to be exposed to the enemy's fire. Surely, then, that must be a bad system. I do not propose now to suggest a substitute, but still the extended use of the semaphore has been spoken of here, and I think it is a very valuable idea, properly placed I believe it would be of the greatest importance. I cannot help thinking that, when the day of battle does come, that commander who comprehensively grasps every detail of the action will bitterly regret a system which forbids him, at the critical moment, to convey those orders which will secure victory, or possibly save a fleet from defeat.

Captain LONG: In common with those who have already spoken, I feel very grateful to Admiral Dowell for the trouble he has taken in bringing this subject before us. I do not propose, however, to follow him through his diagrams, for that

would be indeed quite beyond my power, but I shall study them in the Journal. I have also had the advantage of reading the "Manual of Manœuvres of Her "Majesty's Fleet;" a work which filled me with admiration, and from which I derived a great deal of knowledge. There are one or two things in it which I may with propriety speak about: they do not concern the superstructure of naval tactics but rather the bricks and mortar which form the foundation of it. First, there is a statement to the effect that if a ship has her helm hard over and is going at a certain speed, if you increase the speed that ship will occupy more space in turning. I doubt the accuracy of that statement. Then there is another statement with regard to rectangular and oblique formations; the conclusions arrived at appear to me to be perfectly sound and most admirable, but in the reasoning which precedes, there is a decided flaw which I think should be corrected. It is there stated that the higher the speed the longer will be the change of formation in execution; that I venture to believe is not the case. I have investigated the matter so far as I am able, and it appears to me the time occupied in altering from one formation to another by the oblique method will be found to vary directly as the number of ships and inversely as the product of the sum and difference of the speeds of the ship going at the greatest rate and the ship going at the slowest rate, and that consequently, for the same difference of speeds, the higher the upper limit the shorter will be the time of performing the manœuvre. Since the late Mr. Froude's researches, it is well known that the resistance of a ship at high speed varies in proportion to the fourth power of the speed, whereas at low speeds it only varies as the square; it consequently follows the speed will be reduced much more rapidly if you are going at a high speed than a low one. It appears to me, as young Officers are very properly now required to study these matters, and as they are matters of the very highest importance, we should be exceedingly careful that everything we put before them is tested by actual experiment. There is one other point I should like to mention. In 1873 a paper was read here by Captain Bridge, and some very valuable remarks were made on it by the late Commodore Goodenough. One of his remarks struck me particularly, that we who are what I might call "paper tactitians," who have not had the advantage of serving in a fleet, may do something towards aiding the study of these matters by suggesting sound definitions. Now the "Manual of "Manœuvres" does contain a vast number of definitions, but there are none to define the qualities of a formation. A formation has qualities like everything else, and I think if we get terms to define precisely the qualities of a formation, we are more likely to get accurately in our minds what the value of the formation is. For instance, one very essential quality of any formation is "to be easy to maintain." I should distinguish that quality by the term "coherent," and I should say that a formation which ships found no difficulty in maintaining was a "coherent" formation. Again, an important quality of a formation is that you shall be able to alter course in it without being a long while out of your formation, because if a formation has any value you must be able to alter course in it, and that very quickly. I think a term might be selected for that particular quality of a formation. and perhaps the best term would be "flexibility." I hoped to study the subject further, but have been prevented. Then there is, of course, a strong formation, one in which all the powers of the ships forming it are developed to the utmost. There is one point on which nearly every speaker has touched, and that is, with regard to the speed. I should not pretend for one moment to say what is the best speed at which to go into action;[1] but I do hold, as I did two years ago, that that squadron which can manœuvre at the highest speed, and on the smallest arcs, will have the advantage, and that the enemy will either have to conform to his movements or fly. I think, therefore, it is very important to this nation that money should be found for naval autumn manœuvres. Those manœuvres should be carried out by Officers who have the experience and are well known to possess the ability to conduct such manœuvres properly; and I yet hope we may live to see every formation of a fleet tested by actual practice at high speeds. I was very much struck on reading the able essay of Lieutenant Campbell, who gave the times of altering course in groups ascertained

[1] It appears to depend upon the powers of the ships and the efficiency of the Officers.

by actual practice at 5 knots; and it was stated that at 10 knots the time would probably be one-half. Now, I should like to ask any person who has been accustomed to manœuvre at a speed of 5 knots, how he would feel if he were suddenly told to manœuvre at a speed of 12 knots? I think that if one fleet chooses to steer straight at the enemy, he compels the enemy to steer straight at him. I therefore hold with Admiral Sir George Elliot, "Whatever he does, I go straight at him:" that is my theory of naval tactics.

Captain CURTIS, R.N.: With respect to ramming, and you are going straight at the enemy, if you go straight at him the quicker you go the better, inasmuch as a tallow candle will go through a two inch[1] deal board when fired from a gun. One thing that commends itself most to my mind in Admiral Dowell's lecture, is that he is looking after those who are interested in picking up the wounded; and I think the dispatch vessels and some other boats from the squadron might be detailed to look after that matter, and they might have the title Blue Cross of the Sea for the time being. I wrote to Captain Gurdon some time ago, and he thanked me for writing, in respect to a new system of spar torpedo on which there are only two guys, a fore-guy and an after-guy. I do not know whether I should be correct in describing the whole thing here, because there may possibly be some naval Officers belonging to other nations, and it would not do to let them know. If you see an enemy ramming at you, all you have to do is to turn on the steam capstan and run twelve or fourteen spar torpedoes out. After the danger is over you release the capstan, and the spar torpedoes come alongside. There are no topping lifts required about it, and if you are going to sea for a long voyage, or in peace time, you can unship your spar torpedoes and lay them in-board. I am almost tired of hearing of home defence ships, because the enemy are supposed to be kept to their own ports, and not to come to us; and, moreover, Colonel Hill at the Board of Shipping Interest, on the 18th February last, told the shipping interest that the value of England's mercantile fleet is 100,000,000*l*. Can England afford to have 100,000,000*l*. of shipping to be unemployed? Is it not the fact that as her wealth increases her responsibility increases also? If I have a house with nothing but plated goods in it the burglar won't come to me, but if I have it full of gold and silver he will come. Just so with the enemy, if our riches increase our responsibilities increase. I imagine that at present the expense of the Army and Navy does not increase in proportion to our responsibilities; and I should like to see the colonies welded to the mother country, and bearing their proportion of the expense of the Navy. The colonies do not pay for supporting their trade on the ocean, and as I have said before, our Navy is the Imperial police of the seas, and their duty is to defend our merchant shipping. If we have not a Navy sufficient for the purpose we must create one out of the mercantile marine, and the sooner it is known the better. We require 1,200 ships to support our commerce over 80,000 miles. Captain Colomb told us in 1878, going as straight a course as possible from one port to another, the whole distance is 80,000 miles. Colonel Hill the other day, at the Board of Shipping, said that we have 17,500 reserve, and that will give you about 17½ men to each one of those thousand ships. I think the general public are not aware of the insufficiency of our naval police. I agree with other speakers in thanking Admiral Dowell for his lecture, but I still think he has not sufficient respect for spar torpedoes.[2]

Admiral LUARD, C.B.: This lecture upon naval tactics we must all agree has been a very interesting one; and, perhaps, one thing which it has brought out, is that there can be no consensus of opinion as to the best mode of naval tactics at present. If anyone could have convinced us, or myself individually, of the value of working a fleet in groups, I have no doubt my old friend and companion, Admiral Dowell, would have done it; but I cannot help thinking the service group

[1] The penetration of the board is due to the momentum of the candle and the board not yielding, if fired against a cotton pad the candle will be compressed to a lump.

I should like to call attention to "Clerk's Tactics," which, I think, are not sufficiently known and appreciated. See "Essay on Naval Tactics," by John Clerk, Esq., of Edinburgh. London, 1804.—J. C.

deserves the title which has been so happily invented on the present occasion of "incoherent." It seems to me that it is wilfully throwing away the advantage which we may obtain from working ships in pairs, whereby we could utilize the whole of the practice of our ancestors in naval warfare; and I would suggest that for our next naval essay a more admirable subject could not be proposed than the relative merit of groups of three and pairs for taking ships into action. I am afraid that we sometimes imagine that manœuvres are the basis of tactics, whereas tactics, I take it, should be the basis for our manœuvres; and whatever advantage there may be in exercising Captains and Officers of ships in evolutions with groups of three, I have yet failed to discover any advantage it offers for taking ships into action; and I believe if this subject were proposed for the next naval essay we should induce a far greater number of Officers to take a part in it than by giving them any much more abstruse or abstract question. I am afraid the time at our disposal is almost exhausted, and I am in great hopes that we shall hear some instructive remarks from our Chairman, who is more experienced in this matter than anyone in the Navy, and therefore I will not detain you any longer.

The CHAIRMAN: The very wide range of the subject which Admiral Dowell has brought before us in this lecture, is shown by the fact that each gentleman who has spoken has chosen a separate detail on which to speak. I think the Admiral in his lecture adhered to several very valuable principles, and, recognizing the difficulty that there is in forming any system of tactics at the present moment, for reasons which have been pointed out by several speakers, we should be very careful to adhere to principles, and to stick to those laid down as principles of war by our own Admirals, notably by Lord Nelson. Lord Nelson's name has been alluded to, and I think as to tactics we must continue to do as he did. One of his principles was this, double on your enemy. Now, Admiral Dowell has not attempted to show how in squadrons of equal force he would enable one to double upon the other. Doubling is simply this, that you take one part of the enemy's squadron in detail first. Lord Nelson, when he was attacking at the battle of the Nile, overwhelmed the van of his enemy. At Trafalgar he sent his ships in two columns, destroying the centre of his enemy, and then proceeded to deal with the van and rear. The same possibility exists in some of the groups we have had described to us to-day. Take Case 3. As those red ships are approaching the blue, it is perfectly clear if both squadrons continue their course, the whole weight of the red squadron will be thrown upon two or three ships of the blue, and the Admiral that could do that would have great advantage. Nos. 3 and 6 in the blue group must practically be out of the fight altogether if he can do that; they do not fire a shot, much less are they able to ram. That is one illustration showing that we should stick to the old principles. Admiral Randolph in his remarks drew attention not so much to the matter of tactics as to the basis upon which our fleets are formed, and he has complained that our ships cannot work together because they are not homogeneous. Now, I think we cannot expect to have a brand new fleet every year; we must make use of the fleet we have got. We therefore come to the principle that Admiral Dowell laid down, and which is most important, that the ships should be paired or joined together in threes, formed into separate bodies according to the nature of the ships, and not according to the seniority of the Captains. The last Signal Book has given the power of doing that. Speaking of groups, it says that the principle of the group is that "of a small body of ships united under one "leader." That is a very excellent principle to bear in mind, and considering the difficulty experienced in action owing to the confusion, the smoke, and so on, it will be very difficult for an Admiral to command each of his ships; and if he can rely on the very able men he has around him by selecting the ablest and putting him in charge of two or three as he may think best, he would get the best results. The Captains in command of such groups, though they might not be able to see the signals of the Admiral, would still dispose of a large force, and if they only succeeded in throwing it upon one of the enemy's ships, they would carry out Lord Nelson's principle. I think as we have these ships, all we have to do is to use them. Our forefathers had not similar ships, but they used to bring their ships together and manœuvre them as a fleet. In our case we have some very long ships, such as the "Agincourt," and undoubtedly what is to be done is to put the handiest ships

next to her. So with the "Inflexible;" make the most of her, and make her take care of one of the weakest ships. What we must see to is that we are banded together. Admiral Dowell very properly pointed out that nothing made a fleet so strong as mutual confidence between Admirals and Captains, and that ought to be cultivated by all means. The result is this (and I am now speaking from experience), if you are to have mutual confidence you must be a long time together. Mutual confidence is more engendered by your getting into difficulties and getting successfully out of them, than by anything else. You cannot help making mistakes, but it is the person who, when a mistake is made, pulls his friend through, or is pulled through by his friend, that imparts or imbibes most confidence; and there is nothing so good as that mutual confidence. If that is to be done, you can only get at it by people serving long together, and that is going dead against the principle which appears to hold so much favour at present at Whitehall. At the end of three years, ruthlessly, every Captain is taken out of his ship, however good he may be; and they are now talking about having a new Admiral in the Channel Squadron every two years. I think we ought to look round and see what are the principles for successful action adopted elsewhere. There has been no greater success obtained in late years than that of the German armies. Do they adopt in the German armies a principle of that kind, or one exactly opposite? I take it, it is one exactly the opposite. We never heard of Count Moltke suggesting that an able General should be removed so as to give an opportunity for somebody else to become efficient; on the contrary, their Generals are retained, and when they are tested in war they are found efficient. I think what we should do is to try and select the ablest men, and give them every opportunity to continue at sea, and to serve together, so that we may make the best possible use of our men. Admiral Randolph addressed one question to me about the "Inflexible," which I have no hesitation in answering, because it seems to me that he rather ran counter to a very well established principle of warfare in proposing to divide the "Inflexible," namely, the concentration of force, and you can bring all your force to bear upon one spot more easily when it is combined in one ship than when it is divided into two. In the particular case of attacking a fortress, clearly the one ship with equal force is better than if that power is divided between two ships. Take the case of the forts of the Dardanelles. The great difficulty there is that the water being very deep you must anchor very close to, and consequently if you have to surround one of those forts in order to bring a superior force of guns on it, you must put your ships very close together. My idea if we unfortunately had had to attack those forts was to put the ships at a distance of one cable apart, therefore if I had had two vessels carrying the same armour as the "Inflexible," clearly I should have required double the space in which to put them; the "Inflexible" would have gone in her own length and one cable, but the other two ships must have occupied a great deal more, *i.e.*, their own lengths and two cables, and the force would have been distributed over a larger space. That of course would be to diminish the fire upon the fort.

Admiral RANDOLPH: Would you allow me to make an explanation, and also to supply an omission I made. Our Chairman has rather misunderstood my reference to the "Inflexible." I was speaking with reference to forcing the passage and not to attacking the forts of the Dardanelles. When I alluded to the "Inflexible's" defensive armour, I said that I would say something about that subsequently, but omitted to do so. Now, I have not the faith in that armour that some people may have, because I think it is perfectly clear that it is no use pelting a church tower with marbles or pills, and that an enemy would not be so foolish as to throw his shot away in attacking that armour: what he would do would be to attack her before and abaft it—before by preference—and if he managed to fill a few of her compartments, he would destroy her trim, her speed and manœuvring power, possibly expose her screws, or bring them near the surface, diminishing their power, and then, I think, she would fall an easy victim to two rams.

Admiral DOWELL: With regard to Admiral Randolph's question about electric firing, as I understand electric firing, the Captain gives the order himself: and I imagine that when ships are turning and going to ram, it is not likely that there will be frequent change from one system to the other. It appears to me that the great difficulty of electric firing is the communication with the battery—that is the

one thing which shakes my confidence in it—I have never yet seen any communication between the Officer, the director, and the battery with which I have been satisfied. Mechanical arrangements I have not seen to work satisfactorily. A voice-tube I do not believe in in action. In the "Black Prince" I found the communication between the bridge and the engine-room was a voice-tube, and one day we were performing steam tactics when the ship was necessarily going as slow as possible. I was on the poop and said to the Captain, "How many revolutions are "we going?" He said "Thirteen." Her stern was shaking, and I said, "You must "be mistaken," and we found out that she was going at thirty-three. He said, "I "spoke down the tube and they answered me 'thirteen.'" So the mistake arose, and if that is a sort of thing that would occur in steam tactics, in action it would be worse; therefore I do not believe in it. A messenger would be too slow, in turret ships particularly. But I hope to see this difficulty of electric firing corrected. I am glad to have this opportunity of saying I believe in electric firing for ships in rapid motion and turning, and I think if the electric principle could be extended a little further and used for the communications it would be greatly improved. As to the speed at which my ships are going, of course I must put them at a certain speed, and those ships are put at a speed of 8 knots. You cannot control your enemy's speed, you must take it upon guess-work, or as nearly as you can judge. As to finding it by the sextant, I do not think in action that will ever be possible. It is there that seamanship will come in. You have this advantage in going at 8 knots, that you can have at least 4 knots at your back in a moment, whereas if you are going 12 knots, you can only reduce your speed, and I hold that to reduce speed is wrong if it can possibly be avoided; I would increase, but I would not reduce. Lieutenant Bethell spoke about ramming: now, I agree with Admiral Randolph, that it is better to take ships than to sink them, and he understood me to bring that forward as an argument against ramming. Now, my whole principle is ramming, but I do not believe that because a ship is rammed she is certain to sink; it will not always be the case of the "Vanguard." The very fact of the "Vanguard" having been lost has improved our ships in this respect and those of other nations. The result, I believe, will often be, you may make a great hole in her side and disable her, and you may take her if you defeat the others; what I mean is, that is not the time for you to take her. When you have rammed her you get away clear at once. As to signals, I think I ought to say a word about them. The custom has been to keep the signal to engage the enemy flying during the action. I am happy to say it has been my good fortune to see No. 1 flag, "Engage the Enemy," flying at the masthead for hours. But I do not see any advantage in it; I believe other signals will be required, and that you do not want to crowd your mastheads with flags. It is, no doubt, often difficult to see a flag, but there is a greater difficulty in finding a substitute. We have heard of a masthead semaphore, but I doubt its answering; besides, the enemy have Gatling guns, and they would much more easily knock your masthead semaphore to pieces than they could damage your flags; therefore, though flags are difficult to see, I do not think we have yet arrived at anything to supply their place. I have to thank you very much, and also to thank Admiral Hornby especially, for coming here to-day.

Friday, March 4, 1881.

ADMIRAL SIR COOPER KEY, K.C.B., F.R.S., Lord of the Admiralty, in the Chair.

ON HIS NEW NAVIGATIONAL SOUNDING MACHINE AND DEPTH-GAUGE.

By Sir WILLIAM THOMSON, LL.D., F.R.S., &c., &c.

THE objects sought to be attained by this new instrument are two-fold; first, to protect the wire from rust more completely and more conveniently than was done in the old machine; and secondly, to supersede the necessity for using the chemically-prepared tubes, one of which had to be used every time a cast was taken.

A depth-gauge, which is in some respects satisfactory, already exists in the form of the Massey or Walker log modified to measure distance travelled vertically downwards by the sinker going down to the bottom, and has given good results in Sir Cooper Key's method of flying soundings, which is not so generally known, and not so fully appreciated, as it ought to be. This method, which has been used with perfect success on board a ship running at 12 knots in 40 fathoms of water, as I have myself witnessed on board Her Majesty's ship "Northampton," consists in letting the cord run direct *and unresisted* from a reel near the stern; instead of from coils held by hands stationed along the whole length of the ship's side, as usual in soundings by the old method from a ship under way.

The great labour required to haul in the hemp line and the heavy lead sinker used in this method is an objection seriously telling against its *very* frequent use, and a great advantage will be gained if we can see our way to obtain the same result with less labour. This we do by my method of using fine steel wire. Then, again, the greatest depth at which it is possible to obtain a sounding from a ship running at anything from 8 to 16 knots is probably not equal to that at which we can successfully use the wire. But the Massey or Walker depth-gauge does not give correct indications when used for flying soundings with wire, because the *pull* which must be kept on the wire to prevent it from slackening and kinking prevents the sinker from going vertically down to the bottom. Looking upon the wire as a labour-saving appliance, with the further advantage of being available at speeds and in depths for which it would be impossible to use the lead and hemp line, even by Sir Cooper Key's method, we may consider what may be done to supply the want of a depth-gauge suitable for use with it.

A depth-gauge was patented by Ericsson in the year 1837, in which the required indication was derived from the compression of air in a hollow vessel having two chambers, an outer one and an inner one, connected by a serpentine passage, through which water was allowed to flow into the top of the inner chamber, when the sinker goes down to a greater depth than that which compresses into the volume of the inner chamber, the air that occupied the whole volume of the two chambers and serpentine passage, when the apparatus is first plunged into the water. Many air-compression depth-gauges have been subsequently constructed, but all on the same general principle as Ericsson's. For an up-and-down cast the action of Ericsson's gauge is perfectly satisfactory. If it is let straight down and brought straight up, it will bring up, without spilling any of it, the water which falls into the inner chamber during the descent; but my problem is to secure that no water shall be spilt out of the inner chamber when the gauge is hauled up from the bottom to the surface, and then dashed about from wave to wave in the wake of a ship running at 16 knots. That problem I despair of solving if the inner chamber, which is as it were an uncorked bottle, is more than half-full. If it is less than half-full, I attain the object by guarding the neck of the bottle by a piece of fine tube, projecting downwards like the guard tube of a non-emptying ink-bottle. You may then shake it about as much as you like without spilling or shaking out any of the water, provided it is not more than half-full. If it is anything more than half-full, it is liable to let water be expelled from it by the expanding air within it when, in the course of ascent, the depth-gauge is dragged into a horizontal, or nearly horizontal, position, as it is continually when the ship is going at any speed exceeding 5 or 6 knots. I have found, by actual experience, at a speed of about 12 knots, that when the depth has been great enough to cause the inner chamber to be more than half-filled with water during the descent, water is, during the ascent, irregularly expelled from it in such quantities as to thoroughly vitiate the desired indication of the depth.

In my apparatus there is an outer chamber of brass, and the inner chamber, as in Ericsson's, is a glass measuring tube, and the proportion of the volume of this chamber to the volume of the glass is so arranged that the overflow shall take place when a certain depth has been reached. But I arrange it so that I never use a gauge when the reservoir is more than half-full. When the bottle is *not* more than half-full of water, I am quite satisfied, by much and varied experience, that none is ever thrown out in the practical use of the instrument, whether at high or low speed. I have taken several hundred casts, and never had evidence of any of the depth-measuring water being rejected through knocking about as the gauge is brought up to the surface. Fortified by this experience, I made the *Triple Depth Gauge*, which I will now explain to you. It is composed of three independent gauges, of which the first measures depths of from 11 fathoms to $27\frac{1}{2}$; the second, from $27\frac{1}{2}$ fathoms to $60\frac{1}{2}$; and the third from $60\frac{1}{2}$ to $126\frac{1}{2}$. The outer chamber in each is a brass tube, the inner chamber, or "receiver," as I will call it, is a glass tube. In each the communication between the outer chamber

and the receiver is through a short and very fine aperture bored in the brass mounting by which the tops of the six tubes (three of brass and three of glass) are held together. In gauge No. I the outer chamber is of double the capacity of the receiver; in No. II it is five times; and in No. III it is eleven times. Thus, before the overflow takes place in the No. I gauge, the air must be condensed to one-third of its original bulk, in No. II to one-ninth, and in No. III to one-twelfth. Now the law of the compression of air is, that the density is in simple proportion to the pressure. The pressure of the air in which we live is, when the barometer stands at 29·9, equal to the pressure of $5\frac{1}{2}$ fathoms of sea-water. The weight of the whole column of air standing on a horizontal square inch is 14·7 lbs., which is equal to the weight of, say, a column of water of 1 square inch base and 33 feet (or $5\frac{1}{2}$ fathoms) length. Hence at the depth of $5\frac{1}{2}$ fathoms below the surface of the water the pressure is doubled, an amount equal to the atmospheric pressure being added by the water to the pressure of the atmosphere. From this and from Boyle's law of the compression of air, which I have already quoted, it follows that in a diving-bell, or in the hollow of a diver's helmet, with the interior water-level $5\frac{1}{2}$ fathoms below the surface of the sea, the air is condensed to half its natural bulk. At the depth of twice $5\frac{1}{2}$ fathoms, air is compressed to one-third; at five times $5\frac{1}{2}$ (or $27\frac{1}{2}$) fathoms it is compressed to one-sixth; at eleven times $5\frac{1}{2}$ (or $60\frac{1}{2}$) fathoms air is compressed to one-twelfth; and at twenty-three times $5\frac{1}{2}$ (or $126\frac{1}{2}$) fathoms air is compressed to one twenty-fourth of its natural bulk (or bulk at ordinary atmospheric pressure).

Hence, in No. I gauge, the whole air originally distributed through the outer chamber and receiver becomes compressed into the bulk of the receiver, and at greater depths than 11 fathoms the water overflows into the receiver.

At a depth of $27\frac{1}{2}$ fathoms the air is condensed to one-sixth of its natural bulk, and then No. I reservoir is half-full.

For greater depths, therefore, I distrust No. I gauge, and pass on to No. II. In No. II the capacity of the brass outer chamber is five times the capacity of the glass receiver: thus, No. II begins to overflow at the depth of $27\frac{1}{2}$ fathoms, when No. I is half-full.

At a depth of $60\frac{1}{2}$ fathoms the air is condensed to one-twelfth of its original volume. No. II reservoir is then half-full, and I distrust it for the greater depths, and use instead No. III, which begins to overflow when No. II is at the end of its limit of safe use. No. III has its outer chamber of eleven times the capacity of its glass receiver, and therefore its receiver is half-filled, when the air is condensed to one twenty-fourth part of its bulk; that is, at the depth of $126\frac{1}{2}$ fathoms.

I must now explain the cloth guards which you see across the open mouths of the outer chambers. When I first commenced trials of the triple gauge at sea last June, I sometimes got very puzzlingly vicious indications, which, after much anxious consideration, I traced to the continual wash of water backwards and forwards in the outer chambers, by which drop after drop got shot into the reservoirs viciously, while the gauge was being brought up to

the surface and dragged from wave to wave in the wake of the ship. The remedy I found for this was simply to tie a piece of very fine strong cotton cloth across the open mouths of the brass tubes. The principle is:—very fine cloth becomes airtight when the interstices between the threads and the fibres of each thread are closed by water. Water blocks the passage through such fine holes effectively against air striving to burst through, unless the pressure exceeds that due to a head of 5 or 6 inches of water. Thus wet cloth is absolutely impermeable to air if not forced too much. The pressure required to force air through wet cloth depends on the size of the holes, and the smaller they are, the greater is the amount of pressure it will bear. If you blow through a piece of dry cloth you find that the air goes through with perfect freedom. This is shown by the lamp funnel with dry cotton cloth tied across its mouth, which I hold in my hand. You see I can blow through it freely by the very slightest effort. But now, after I have dipped the cloth in water, I cannot blow air through it at all without very considerable effort; and when I plunge it with the open end downwards in this deep glass basin of water, you see that absolutely no air passes through the wet cloth till the level of the water inside the tube is 5 inches below the level in the basin outside the tube. But when I place the funnel with the cloth-guarded end downwards in the basin of water you see that water passes through the wet cloth with perfect ease. The precise object of the cloth guards in the depth-gauge is, to allow the pressure of the expanding air to expel the last drop of water from the outer chamber before any air escapes at all. After the outer chamber is thus perfectly drained of water, a quantity of the air equal to that displaced by the water which has fallen into the inner chamber is expelled during the last part of the ascent of the gauge to the surface. Thus the gauge comes up to the surface without any water in it at all except that which remains in the receiver, and which marks the depth. I have frequently tested the efficiency of the cloth guard by letting the gauge and sinker slowly down to the surface of the sea by proper manipulation of the sounding machine, and towing them along the surface from wave to wave for ten minutes in rough water behind a vessel running at 8 or 9 knots, with various lengths of wire, from 10 to 30 fathoms; and I have never found any water to be lodged in the outer chamber, or any change in the quantities of water in the inner chambers (or receivers) to be produced, by the violent shocks which the instrument experienced in the circumstances. This severe test proves the action of the cloth guard to be practically perfect.

The three glass tubes (receivers) are all closed by one india-rubber pad, a quarter of an inch thick, screwed to a flat brass disc. The more continually india-rubber, in such an application, is kept in use, the less liability there is of its going wrong. If it does go wrong in the course of years, it can easily be repaired.

The new sounding machine is kept, in intervals between casts, in a box filled with lime water, under the surface of which the wheel and wire are immersed. This is a great improvement on the old machine, described in this Institution two years ago, in which the wire could

only be immersed in protective liquid, by taking the wheel off its bearings and carrying to a separate tank of lime water, or of oil, or of solution of caustic soda. Thus, in the intervals between casts, in making the English Channel for example by a homeward bound ship, or in going down St. George's Channel by an outward bound ship from the Clyde, the wire of the old sounding machine was often left for twenty-four or forty-eight hours unprotected on the wheel placed over the taffrail, and so became weakened by rust.

In the new machine, the wheel and wire are dipped in lime water instantly after every cast, even when casts are being taken every five minutes with not a minute's interval. From six months' experience of the working of the new machine, and of the condition of the wire which I have observed from day to day and from month to month in the course of practical work with it, I am able to say with much confidence regarding the wire itself, that if it is *always* kept in lime water at all times between the acts of taking casts, it will be as good after twenty years' service as it is when first supplied for use, and will remain bright and absolutely free from rust. The machine and the depth gauge, and the whole apparatus in position for use, with a fair-lead pulley fixed to the taffrail, are represented in the following drawings (Figs. 1, 2, 3, 4).

Description of Diagrams.

Fig. 1 shows the machine with a small weight A (3 lbs. of lead) resting on the long weight W (56 lbs. of iron), and the brake cord B slack as it is when the wire is being wound in.

To put on the brake:—Lift the long weight W by the hand-rope E, and place the small weight A in the recess in the large weight, and then slack the hand-rope again. While a sounding is being taken, the long weight W is held up by the rope E, so as to allow the small weight A to hang freely. As soon as the sinker reaches the bottom the brake is put on by easing the rope E, and allowing the weight W to be supported, by means of its jaws, on the small weight A. The whole weight of W should not be allowed to come suddenly on A, but it should be eased down gradually. If when the whole weight of W is resting on A, the wire still continues to run out, the brakesman should press his hand down on the top of W, until he stops the wheel.

Figs 2 and 3 are drawings of the depth-gauge. Fig. 2 shows the complete gauge, and Fig. 3 the inside tubes.

a, Fig. 2, is a screw for screwing up the valve *d* against the ends of the three glass tubes, g^1, g^2, g^3. Before the gauge is allowed to go down it should be examined to see that there is no water in any of the tubes, and then the valve *d* should be closed by means of the screw *a*.

The inside tubes can be taken out of the case by unscrewing the top of the case *c*. At *f* a small piece of the case is cut away to facilitate the getting of the tubes out.

At the bottom of the brass tubes b^1, b^2, Fig. 3, there is a piece of very fine strong cotton or linen cloth. If it becomes necessary to

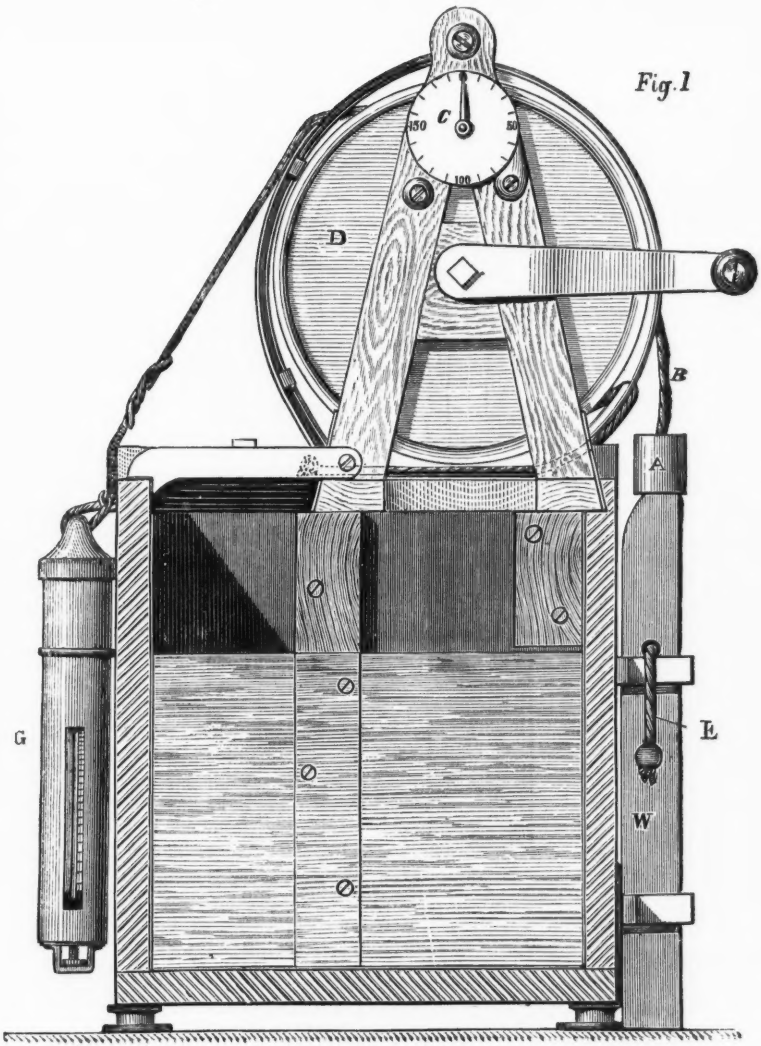


Fig. 1

renew this, the brass tube must be heated gently to soften the wax on the screw of the tube, and the cap then screwed off. A fresh piece of cloth can then be tied on, and the cap screwed back to its original position, and fixed with a little beeswax or lard. If there is a

Fig. 3.

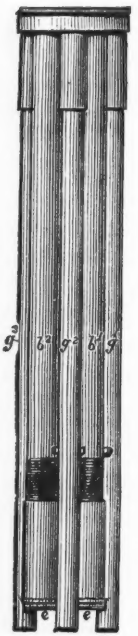
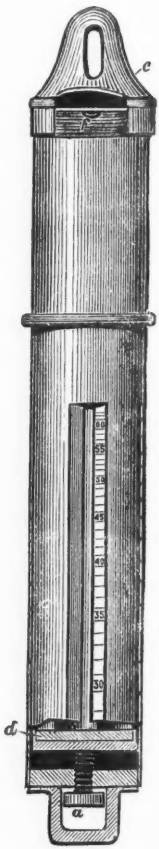


Fig. 2



difficulty in starting the cap, it may be done by binding a piece of twine twice around it, and tightening it by pulling on the ends and pressing the brass cap with a finger or thumb applied to it where the twine is round it.

Fig. 4 shows the sounding machine fixed on board a ship with the stern pulley on the taffrail. Between the sinker and the depth-gauge there is a two-fathom length of *plaited* rope, and between the depth-gauge and the link at the end of the wire there are other two fathoms

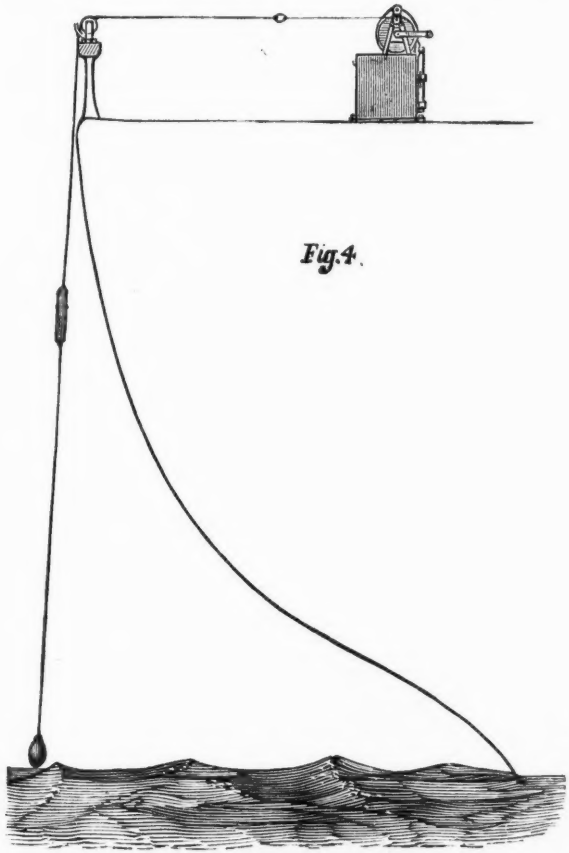


Fig. 4.

of *plaited* rope. It is very important that this rope should be plaited, *not twisted*. If twisted rope is used, the turns from the rope go into the wire, and it becomes very liable to kink.

Admiral Sir ERASMUS OMMANNEY: What is the limit of depth at which this gauge is applicable?

Sir WILLIAM THOMSON: The depth-gauge is graduated to 126 fathoms; but from

90 to 100 fathoms is about the greatest depth that can be reached with my present arrangements when you are going at 16 knots. At the speed of 11 or 12 knots, a cast can be taken at 110 or 120 fathoms with ease.

Captain Sir GEORGE NARES, R.N., K.C.B., F.R.S.: Having worked a good deal with wire myself, I can speak practically and say that all that Sir William Thomson has put before us in his lecture is of practical value. As a seaman I should like to thank Sir William Thomson for the trouble he has taken to go out of his way, as we may say, to improve the methods we have for sounding and judging our distance at sea. He is teaching us how to sound; he has got a new compass for us, and he is also working to simplify the characteristics of lighthouses for our use when approaching our shores. The use of wire is perfectly practicable, and in consequence of the wire sounding, I hope we shall shortly see no such thing on our chart as a "no bottom." With the wire sounding machine in a steam pinnace the surveying ships can send their boats away with the assurance that the Officer will not return with a "no bottom," after a depth of 100 fathoms is reached; this is very important, because just as we get off the old line of soundings at 100 fathoms, it is always most interesting to know the section down into the deep water; so we hope that there will be no such thing as "no bottom" again. Sir William Thomson says we can put the wire into the lime water after every sounding. In practice I prefer to let the wire rest instead of taking the trouble of putting it into the lime water, and if he can improve upon that plan, he will do us great service. Perhaps it might be possible to take a little larger sized wire and galvanize it, or use it any other way so as to do away with lime water, and if he can tell us that we can do that we shall be very much obliged to him. I need not go into the question as to the trouble occasioned by the wire kinking. Sir William Thomson, when working in this direction, has most probably been conducting the experiments himself. Wire is very ticklish sounding rope, and you are obliged to look after it yourself; it is scarcely a thing that you can put into the hands of a quartermaster or an ordinary seaman to look after, until they have become experienced in its use, and there is always a little trouble connected with its kinking; but that may be got over. I think the pressure gauge is very important indeed. We have never been quite contented with the old deep-sea sounding apparatus, and all surveying ships take the utmost trouble to get a precise up-and-down sounding, no matter whether it goes to 3,000 or 4,000 fathoms. Now, Sir William Thomson has given us a perfectly new sounding machine, which I think as far as he has explained it to-day is certainly most successful. Not only can it be used in a steamer, but also in a sailing vessel, when hove-to. We all know the difficulty of getting an up-and-down sounding under such circumstances; but with this new machine, if we do drift slightly to leeward, it goes straight down and we shall obtain a true sounding. There is one important point to which I wish to draw attention, namely, it has got abroad very widely that, owing to Sir William Thomson's plan, ships can get a sounding when running up Channel at the rate of 10 or 12 knots. I think we ought to try and prevent that notion from getting abroad, because when a ship is going 12 knots—a mile in five minutes—I defy any man to take a sounding at 30 or 50 fathoms and to get his line in before he has run his mile, then if he doubts the correctness of the sounding, and tries for a second one, long before he is quite certain of his position he is on shore.

Captain CURTIS, R.N.: Notwithstanding what has been said by the last speaker, I do not think it is possible to get an up-and-down sounding at 2,000 fathoms on account of the under and upper currents, which must not be forgotten. There is one point on which Sir William Thomson did not inform us: I should like to know whether, before the sounding machine is ready for work again, it is not necessary to let the water out of the tube.

Sir WILLIAM THOMSON: I should have explained that all that has to be done is, to unscrew a valve, let the water out, and screw it up again; it is done in ten seconds of time.

Captain CURTIS: There is one other suggestion I should like to make, and that is that the snatch-block should be on a swivel, otherwise you will find that it will not lead to its work and the machine, there will be a slip. We constantly hear of vessels being lost. Steamers steer from point to point; they steer within half a

point to clear them for the next point. Now my experience on the coast of Africa is that in going from point to point across a bay, if you set a course to clear another point at half a point of the compass, you will not do it, because the current sends you into the bight of the bay, and that will take you on shore, and that is the way in which I account for many of these vessels being lost. It is no satisfaction to the general public to know that those ships are insured—an insurance that the public have to pay for indirectly; and besides there are the widows and orphans to be supported. Now I wish to know whether we should not hint to the Board of Trade that vessels carrying passengers should be compelled to have some machine of this sort. We insist upon our railways having proper brakes, and when a vessel is running into danger we ought to have a brake which we can use. I should call this the ocean brake, by which, when a man is at all doubtful about his position, he can take soundings. As I have said before in this Institution there was an ex-navigating officer navigating a vessel from Bilbao to Bristol; he wanted to make Lundy Island, and he made Cape Ushant in consequence of caulking his decks when at Bilbao, and the caulker, putting in the magnets, reversing the poles, but the Captain did not find it out until he got to Gloucester Docks. There is one other point to which I wish to refer. That little bit of cambric seems to be a very small matter to resist air when it is wet. I would wish, however, to say to the public at large that this is one of the most important matters that they can consider. When I read Sir William Thomson's account of this calico and fine cambric resisting air, when wet, I immediately set to work and experimented with inflated bags. I had a small bag about half the size of a pocket-handkerchief, and that I found would support a 6 lb. weight in the water, 8 lbs. of air will support 10 lbs. of dead weight and keep it flush with the water. Now if people could only keep their nerves on board ship, and in case of disaster to the vessel could utilize the pillowslips, or shirts, or whatever is handy, wet them and inflate them, a good deal of life might be saved. A shirt with the sleeves tied at either end, wetted and inflated with air would float any man on shore. I have had a small bag in a bath with a piece of pantile of from 5 to 6 lbs. weight on it, which has been supported for twenty-four hours. If I can do that I cannot see why this might not be utilized for saving life, and I think it should be made as widely known as possible. Of course, if you go to certain depths, the air will get in, but under moderate pressures it will not. That has been the result of my experiments which have extended for upwards of a month.

Captain BOWDEN SMITH, R.N.: Does the lead sinker become detached when the machine reaches the bottom, or is it heaved up again every time?

Sir WILLIAM THOMSON: It is heaved up every time and brings with it a specimen of the sea bottom.

Captain BOWDEN SMITH: May I ask if any of the mail steamers have adopted your machine?

Sir WILLIAM THOMSON: The White Star Line, the Anchor Line, the Pacific and Oriental, the Cape Mail, and the Cunard, partly; it is not yet complete.

Captain LONG, R.N.: I should like to make one remark confirmatory of what Sir George Nares said with regard to the time occupied in taking soundings. It is only repeated soundings that are of value, for I believe it is considered that isolated soundings are of hardly any use. Under those circumstances the time occupied is a very great consideration, because the use of sounding in dangerous circumstances depends upon the rapidity with which it can be carried out.

The Earl of KINTORE: May I be allowed to add that I had myself an opportunity three days since of seeing Sir William Thomson's sounding machine in operation on board the new Allan steamer running from Glasgow to Liverpool, at a speed of 12 knots, and that it worked throughout with the most absolute and perfect success?

Captain WHARTON, R.N.: I unfortunately did not enter the theatre in time to hear the description of Sir William Thomson's new machine, but I have just returned from a 4½ years' voyage, in command of a surveying ship, where I have had some experience with his first machine. I took a good deal of trouble to compare the soundings obtained by it with those obtained by our own plan, working our own method with the old line, on one side, and Sir William Thomson's machine on the other, and I invariably found it correct. I did not adopt it, however, because I found that we

got quicker soundings with our own arrangement; that, however, was in consequence of the exceptional fittings of the ship, and had nothing to do with the value of Sir William Thomson's machine as a navigational machine. Just at the point where our method failed from the speed of the ship, Sir William Thomson failed from the smallness of his scale. I think that with a very little practice the men will be able to use it without difficulty. That is my experience. Sir George Nares spoke about steamers running at great speed, and said that the wire might kink. This is a very different thing from deep-sea soundings, for in that case the ship is stopped, and as the machine is going down to great depths, at a comparatively low speed, when the ship rises and falls there *is* a chance of kinking; but, when the vessel is going through the water at a great speed, I found that there was never any kinking at all. I cannot say anything more about this new machine, but it seems to me of great value. I understand that Sir William Thomson has enlarged the scale, which certainly is a great improvement, for with the old machine it was rather difficult to read to 4 or 5 fathoms when the lead fell over on one side, and the tube got marked higher on one side than the other. You are supposed to take the lowest reading, but I did not find it always easy to read.

The CHAIRMAN: When you mention the companies that have adopted the sounding machine, are you speaking of the new one you have explained to-day, or the old machine?

Sir WILLIAM THOMSON: The old one; but each of these companies takes the new one for their new ships.

The CHAIRMAN: Before asking you to allow me to give your thanks to Sir William Thomson I wish to make one or two observations, as he has mentioned my name in connection with a certain mode of sounding that was not my idea or invention; but I should like to describe it to you, as it is a step towards what Sir William Thomson has been describing to us. It was first proposed by Staff-Commander Tracey, and was carried out in two ships in which I hoisted my flag, by Captain Fisher and Captain Tracey. We know by the old plan it took a quarter of an hour to get the line passed along, and the whole watch had to come on deck to haul it in; the result was great loss of time and loss of patience, and there was thus every inducement of never taking a sounding if you could possibly avoid it. Rounding-to and getting bottom would certainly take from twenty minutes to half an hour, whether you were under sail or under steam, before the ship was again on her course. The way in which we used to sound was this: we had our line on a reel, with an iron spindle, so that it ran with perfect ease. The reel was held on the quarter-deck, the lead was passed on to the poop and eased down close to the water's edge. A man at the poop rails with the line in his hand, at the words "Let go," ran aft, giving the line a good swing off the reel, and down went the lead without a check; thus when leading a fleet either in thick or in fine weather we were enabled to continue at a speed of 6, 7, or 8 knots, and get soundings in 50 or 60 fathoms without heaving-to. That was a mode of using the old appliances in the best way with Walker's machine. A step in advance was made by Sir William Thomson by introducing the wire on a reel which might be used with Walker's machine, and by which you could get the depth without heaving-to faster than we could with the old line. Then discarding Walker's machine he adopted the glass tube which has been in use in all the companies that Sir William Thomson has spoken of. That glass tube has this advantage, that they form a record of your soundings by themselves. You take the tubes and put them in a rack, and can afterwards examine the soundings. There is no chance of a sounding being lost, because you can examine it the day afterwards if you like. No doubt, however, there is an inconvenience on board a ship in using the glass tubes, they break, and besides that there is a little uncertainty in getting the soundings; for sometimes the mark is a little on one side, and at the greater depths the indications are very small; you cannot read them off within 3 or 4 fathoms. I believe that this new depth gauge Sir William Thomson has now added to his wire reel will be a very great improvement on anything we had before. It has been under trial in one or two ships, and nothing but good reports are made of it. I may say also the glass tube system is introduced into all our troop-ships, and in a great many of the ships-of-war all over the world, and has been tried with very great success. But what-

ever success it has, I hope the warning Sir George Nares gave just now will be sounded throughout the length and breadth of the land; and that although you may be able to obtain soundings at a speed of 12 or 14 knots, ships should not trust to getting them at that speed when making land at night in fog, for doing so would be running a great risk; and if any such accident should result from the introduction of this sounding machine, I may say it will do more harm than good; but I do not believe it will. I have too much faith in the good sense of Captains, both in the Royal and Mercantile Navies, to believe that it will have that effect; and with that proviso, I believe this will be one of the most valuable aids to navigation that has been introduced of late years.

Sir WILLIAM THOMSON, in reply, said: Sir George Nares has asked if some other method may be found than the use of lime water for preserving the wire. I most cordially agreed with him in this desire previously to the introduction of the new machine, but I now hope that Sir George Nares will agree with me that lime water is satisfactory. In the old machine the trouble of taking the wheel off its bearings, putting it into the lime water, and bringing it out again for a fresh cast, was very great. The separation of the lime water tank and the machine was an annoyance all round. That, however, is now obviated; the machine is conveniently kept in a box in any case, and that is all the apparatus now needed for the protection against rust. Look at it on the ship's deck; you need not know that the lime water is there at all, and you simply see a box convenient for keeping the machine in when out of use. Besides keeping the wire bright and free from rust, the arrangement for placing the machine in the box of lime-water in the intervals between casts has the great advantage of allowing the iron to be kept at a convenient temperature in very cold weather, by occasionally pouring a kettleful of hot water into the box, and by that means the whole of the machine will be kept at such a temperature as to be capable of being used. That will be found a very great advantage in winter time in the North Atlantic, the German Ocean, and anywhere else where there is severe frost, reducing the iron to such a temperature that it could not, unless artificially warmed, be touched or handled without blistering the hands. Sir George Nares also suggested the use of thicker wire, and that it should be galvanized. No doubt galvanizing would work very well, and for some surveying work a stronger wire galvanized would be more convenient. The greatest strength of galvanized wire, however, is only 52 tons to the square inch, whereas the strength of the special steel wire which I use is 130 tons; so that the steel wire for my sounding machine is more than twice as strong as the galvanized steel wire hitherto made. For wire-rope dredging the galvanized wire may no doubt be found more convenient than ungalvanized, all things considered in practice: but the high quality of the ungalvanized steel pianoforte-wire is of vital importance in deep-sea survey soundings in depths of from 1,000 to 5,000 fathoms, and in flying soundings at all depths; so that I think the lime water is to be regarded not as a disadvantage but as an advantage in this machine. As to the very important notes of warning Sir George Nares has given, I feel them most deeply. I may say, however, that it is not the machine, but the want of the machine, or the non-use of the machine, or the omission to take soundings by the older methods, in ninety-nine out of a hundred cases of vessels running ashore in moderate weather, whether foggy or thick or clear, which is to blame. I knew a case where with a sounding machine on board the ship was as much out of her course as $2\frac{1}{2}$ points of the compass. They heard a sound which really was the fog-siren of Sunda, but they assumed it was the fog-horn of a steamer. The Captain thought he had one of the great Transatlantic steamers on his port bow, and that he was therefore safe in mid-channel, and though he had my machine on board he did not take any sounding, and went on shore on Cantyre. I really think this machine can never be a source of danger, but will, on the other hand, when used with proper diligence, be a help to navigation, by telling the ship's place long before she could be in danger. With regard to my old chemically prepared glass gauges, the trouble and expense of preparation prevented as many soundings from being taken as ought to be taken, because the question of expense comes in. In many cases soundings ought to be taken every ten minutes for five or six hours, and then the cost of the tubes would

be too much; thus the necessity for the chemical preparation of the tube on my old system diminished the number of soundings that could (practically speaking) be taken: but with my new machine there is not the slightest difficulty in taking a sounding every five or six minutes. As to the time occupied, you must remember that there is, in almost all localities, a good hour, and generally much more, between the hundred fathoms' sounding and danger. Off Ushant, for example, for a ship approaching the British Channel there are 35 miles from the hundred fathoms' line to the nearest danger ("The Saints," or "Chaussée de Sein"); and before the danger-line of 70 fathoms is reached half a dozen good casts can be taken. The right principle is not to wait until you are in danger and then to take the cast, but to take a cast before you run into danger. I know there used to be a feeling against taking soundings when the ship had to be stopped or rounded-to every time, especially on passenger ships, because the Captains knew very well that the passengers would say, "Oh, he is "taking soundings, he does not know where he is," and would become alarmed. What ought to be done, is to do as the blind man does, who feels his way with a stick: that is to say, when you do not *see* where you are, use the lead incessantly to *feel* your way in any water of less than 120 fathoms. This can only be done practically when you can take soundings without reducing speed. Captain Curtis remarked that the stern-pulley could be put on a swivel. I have a special pulley such as he has suggested, which I use in cases in which it is suitable. His suggestion as to using wet cloth for floating seems to me to be an extremely valuable one. No doubt women are often saved from sinking by their dress and men by their shirt-sleeves. It must be remembered, however, that wet cloth does not provide a very *hardy* floater. If the difference of depth between highest and lowest point of a completely submerged bag of such cloth as you have seen in my depth-gauge and in the demonstrative experiments which I showed, be greater than 6 inches, air will escape through the cloth in its uppermost parts.

The CHAIRMAN: In conclusion, I would mention one point connected with the use of the wire. It seems to have an advantage which has not been pointed out, namely, that the regularity with which it goes out makes it very easy, when you are going at a fixed speed, to obtain a coefficient to apply to the amount of line which has run out, by which you may obtain the depth, so that you have a check on your gauge. The length of wire paid out is registered on the reel, and as you know when the lead touches the bottom what length of wire is out, and knowing the speed also at which you are going, you will be able to obtain the depth pretty accurately without waiting to read it off the depth-gauge; it thus acts as a check to the gauge. I am sure it will be your pleasure to return your thanks to Sir William Thomson for his very interesting lecture.